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SCIENTIFIC RESEARCH AND UNIVERSITY FINANCES

HEARINGS

BEFORE THE

TASK FORCE ON SCIENCE POLICY

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

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SCIENTIFIC RESEARCH AND UNIVERSITY FINANCES

TUESDAY, SEPTEMBER 16, 1986

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SCIENCE POLICY TASK FORCE,
Washington, DC.

The task force met, pursuant to call, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the task force) presiding.

Mr. FUQUA. Good morning ladies and gentlemen.

Today the Science Policy Task Force will begin a 2-day hearing on the topic of "Scientific Research and University Finances."

A financially healthy university research environment is important not only for the United States to maintain a strong leadership role in science, but also to attract the best minds and train them as the scientists and engineers for the future.

More than a year ago we asked the Government Accounting Office to undertake a study to analyze the financial health of the United States research universities and their current and future ability to sustain a major part of the research enterprise.

Recently, the GAO completed a report in which the findings and conclusions of that study are summarized. That report will form the basis for the hearing, which will be the last topical hearing of by the Science Policy Task Force.

Before I introduce the first witness. I also want to use this occasion to announce the changes in our schedule for the release of our task force report.

When we began the 2-year science policy study 21 months ago, in January 1985, we had expected to complete the task force hearings this summer. We hoped then to have a draft of our report ready just about now, in September. As it has turned out, the drafting of the report is taking more time than we expected. As a result, the completed draft will not be ready until the end of the year, in December.

It is, however, still our expectation to release the report in draft form, and to seek comments on the draft from all interested parties. Those comments will be received through written letters or statements and through public hearings. I am hopeful that my successor as chairman of the Science and Technology Committee will find it possible to hold such hearings early next year.

Meanwhile, I have concluded that it would be useful to make a statement of my own views to my colleagues in the House. That

statement will be personal in nature and will not necessarily coincide in every respect with the views of the other members of the task force. It will cover many of the topics which have been considered by the task force and certain other topics in the fields of the energy research and space research. I expect that statement to be printed and available in mid-October.

[The prepared opening statement of Mr. Lujan follows:]

OPENING STATEMENT HON. MANUEL LUJAN, JR. (R-NM), SCIENCE POLICY TASK FORCE

Thank you, Mr. Chairman.

I would like to note that this begins our last set of hearings of the Science Policy Task Force on the many issues which we identified for this Congressional study in our agenda nearly two years ago. It has been my pleasure and honor to work with you in conducting nearly forty hearings to implement that agenda, and I feel that the record we have compiled represents the most complete Congressional oversight of the Federal role in supporting American science. I am almost sorry to admit that we did our job so well that analyzing our record is taking longer than initially planned, but I think that your revised schedule best serves us by bringing our study to a thoughtful, measured conclusion. I will certainly encourage the next Chairman of the Science Committee to hold hearings on our final report as early next year as practicable to allow us time to begin implementing whatever recommendations we agree on in the next Congress.

Before closing, Mr. Chairman, I would like to commend you for your foresight and dedication in initiating and conducting this Science Policy Task Force. You have done this Committee and the Congress an enormous favor by focusing our attention on the long-term requirements of the American science community, and I suspect that the considerable record compiled by this task Force will provide a sound basis for policy changes for a long time to come. I hope that after your retirement from Congress, we can continue to call upon you for counsel on these and other matters.

Thank you, Mr. Chairman.

Mr. FUQUA. At this time, I want to introduce the first witness. I would have liked to start with the testimony by the representatives of the Government Accounting Office. However, in order to accommodate the travel schedule of Dr. David W. Adamany, president of Wayne State University in Detroit, MI, I will ask him to be our first witness. It certainly is a pleasure to welcome you.

I also understand that you come from a varied background in Government as well as academia. I am sure that having sat on the other side of the table in trying to determine the priorities of spending and so forth, that you come with a very broad background to help make this hearing even more meaningful.

Dr. Adamany, we are very pleased to welcome you before us today.

[A biographical sketch of Dr. Adamany follows:]

DR. DAVID W. ADAMANY

David Adamany is a graduate of Harvard College and the Harvard Law School. After serving as special assistant to the attorney general of Wisconsin and member of the Wisconsin Public Service Commission, he obtained his masters and doctorate in political science at the University of Wisconsin. Adamany has held teaching posts at Wisconsin State University-Whitewater, the University of Wisconsin-Madison, and Wesleyan University, where he also served as Dean of the College. He served for three years as vice president for academic affairs and professor of political science at California State University, Long Beach. As a campus vice president in the nineteen-campus California State University System, Adamany served on the systemwide committee of academic vice presidents and its library advisory committee. He authored a report for the Sloan Commission on Government and Higher Education on the governance of higher education in California.

Until July 1, 1982, Adamany served as vice president for academic affairs and professor of political science at the University of Maryland. He was vice chair of the gubernatorially-appointed Segmental Advisory Committee to the State Board of Higher Education. In 1981 he authored a report for the University's Board of Regents describing the six-segment structure of higher education in Maryland and analyzing alternative modes of organization of the four-year segments and institutions.

He is now president and professor of law and political science at Wayne State University, a constitutionally autonomous institution.

Adamany has had an extensive background in public affairs as a member of the Wisconsin Public Service Commission, chairman of the Wisconsin Council on Criminal Justice, chairman of the Wisconsin State Elections Board, and Secretary of the Wisconsin Department of Revenue, a gubernatorial cabinet post. As an adviser to Governor Patrick J. Lucey, Adamany played a key role in developing the proposal which in 1972 lead to the creation of the University of Wisconsin System under a single Board of Regents.

Adamany now serves on several boards, including the Detroit Economic Growth Corporation, the Detroit Symphony Orchestra, Michigan Cancer Foundation, New Detroit, and the United Foundation; and he also serves on the executive committees of the Detroit Medical Center and the Metropolitan Center for High Technology. He is the author of many articles and books on constitutional law, the judicial process, American politics, and campaign finance.

STATEMENT OF DR. DAVID W. ADAMANY, PRESIDENT, WAYNE STATE UNIVERSITY, DETROIT, MI

Dr. ADAMANY. Mr. Chairman, thank you very much for having me before your committee today. I appreciate that I am able to testify first in order to make a plane.

May I say, that in appearing before you I bring a somewhat different perspective from the testimony you are accustomed to hearing, which is from the American Association of Universities, and the largest of the Nation's research universities.

It is important to call attention of this committee to the fact that there are an important second tier of research universities throughout the country, that do important research, that compete successfully for Federal support, and make very significant investments in research on their own.

I would especially emphasize that many of these research universities are located in the Nation's urban areas, and though late starting as universities, have a very important role to play. So perhaps my testimony today can touch upon some aspects of the second tier research universities and especially those in urban areas.

May I say briefly that, in our university, we continue each year, as do many of the other public urban universities, to rank in the top 100 universities in the country in total expenditures for research so that we are reasonably competitive and are conducting research which are nationally recognized.

I do wish to say that for Wayne State University and others similar to it, we do not have the advantage of receiving land grant research funds. So the research program that we engage is necessarily reliant on other sources, including other Federal sources.

If I may for just a moment call attention to the fact that the Congress is now debating the renewal of the Higher Education Act, including title XI, which is the Urban Grant University Act. While that act has not been funded, we hope it will survive in the current reauthorization because it would be the source for research funding for the Nation's urban universities.

If I may then come to, perhaps, a brief characterization of the kind of activity that might be found in the Nation's research universities, I will mention that at Wayne State University our total research expenditures are generally about $28 million, or about 11 percent of the university's total spending. While this is a smaller research program than in the universities generally studied in the GAO report, nonetheless, I call attention to the fact that 65 percent of our research funds are obtained Federal Government in a competitive way. We commit about 14 percent of the research funds from our own budget. We are very pleased that foundations and industry provide another 17 percent of research funds. In the period of 1980 to 1985, while the university's budget has increased 27 percent, our Federal funds for research have increased 28 percent. So Federal funds are growing for us at a more rapid rate then the university's budget, which is not the typical pattern found in the GAO report.

Overall, our funding for research has increased 37 percent. So we represent a group of universities which, though they are not in the top group of research universities, are making very substantial efforts to improve their research programs, both with the assistance of the Federal Government and especially by reallocation of their own funds.

It is nonetheless true that nationally, as GAO report indicates, we are not increasing Federal research funding as rapidly as the budget of universities are increasing, and this is a source of very considerable concern to all of us in the university research community.

I think it is important for us to say that despite very significant efforts to build up research programs by the State governments, there is no prospect whatever, that I can tell, that the States would be able to make up for a decline in Federal funds for research as a proportion of university budgets.

In Michigan, we have made a special effort to allocate funds for research, the State legislature has made a special effort, and they have allocated some $25 million to be shared by the University of Michigan, Michigan State University, Wayne State University, and Michigan Technological University, which are the four research institutions in our 15-campus system. Nonetheless, even a State effort to make a commitment of $25 million will not offset any significant diminution of Federal effort in research funding.

Perhaps, if I may, Mr. Chairman, this would be a time for me to acknowledge your comment that I played another role in government, and served for an extended period as the head of the State tax department in the State of Wisconsin. Perhaps the most unpopular post in any government is the post of tax collector. I was proud that during two State administrations we raised taxes substantially in Wisconsin, largely for the support of education. It was very clear to me in that State, as it is in Michigan, that no matter what State effort might be made through taxation of its own people. The principal allocation of those funds must be to instructional programs and to provide the basic facilities of higher education, and that it is unlikely that State funds will ever be sufficient to in any way replace the Federal commitment to research activity.

I would like to make the comment that a diminution or perhaps a slowed rate of improvement to be more accurate, in Federal support for research would fundamentally change the partnership between the States and the Federal Government in higher education that has been developing since World War II. In that period the States that generally provided the funds for instruction, for teaching, for academic support such as computing and libraries, for other operating expenses and for most university facilities.

The National Government in that partnership has made its commitment in two important areas: student financial aid to promote equal educational opportunity, and research. In the category of research, the National Government has in times past provided some funds for research facilities and research libraries. There has then followed a period in which funding was eliminated at the Federal level for those purposes. Those of us in the universities are very grateful that last year, in 1985, a smaller amount, $28 million was allocated for university research facilities and the upgrade of equipment. That funding, though very modest by past standards, is very helpful.

If I may then, Mr. Chairman, in approaching several key points in my testimony take a few moments to talk specifically about the role that universities in the urban centers may have in the national research effort. I would like especially to call attention to the problems of research funding in those areas of science and technology that bear most heavily on the Nation's manufacturing industries.

In 1984, the Office of Technology Assessment issued a report entitled "Computerized Manufacturing Automation." The report noted the surge of automation that will occur in the manufacturing industry. It pointed out that the greatest early impact of automation would be in the East North Central States. It called attention to our lack of preparation for the surge of automation in manufacturing. It called attention to the fact that work forces are not sufficiently educated to meet the new demands of manufacturing plants. And it especially emphasizes that the Nation's applied research in programmable automation was deficient for international competition.

There is no doubt, especially in the minds of those of us in manufacturing centers like Detroit, that American industry is now investing very heavily in both applied and basic research in the area of programmable automation for manufacturing purposes. For universities in these urban centers, a commitment to this research is also very important.

The Department of Defense has increased its commitment to research in some areas relating to manufacturing automation, such as artificial intelligence and machine vision. But the fact remains that the United States is substantially under-invested in research that will allow our manufacturing industries, particularly those in the Midwest and the Northeast, to become more competitive in cost, production quality, and total output. Unless this Nation is going to follow a policy of deindustrialization, and allow its heavy industry to go offshore, there is an urgent need for a partnership between the National Government, industry, and the universities

to expand basic and applied research in all aspects of programmable automation and machine intelligence.

This, I believe, Mr. Chairman, is where the emerging urban universities, mainly as I said, in the second tier of the national research universities, play a special role. Most of the production facilities as well as the research divisions of our major manufacturing corporations are located in the Nation's large metropolitan areas. The Nation's urban universities are natural partners for these industries. In fact, we already trained most of their engineers and a large share of their research personnel. Many of our faculty members have consulting or research relationships with these companies. And many of our universities already have joint research projects with industry in our area. The urban universities are especially able, and on the whole, are especially willing to expand these applied relationships with industry in their community. I would hope that national policy in science and technology would give us substantial encouragement in these joint efforts.

The second major point I wish to make, Mr. Chairman, relates to the pressing needs for research personnel. The facts are clear enough. The United States is headed for a dramatic shortage of research personnel in science, engineering, and mathematics. This shortage will occur at just the time when university faculty members in these areas will be retiring in large numbers, when industry will begin to reinvest in basic research, and when the national Government will again be financially capable of expanding its research commitments.

The Government Accounting Office's report does identify a concern by the universities about the lack of adequate financial support for graduate research assistants. It notes also that foreign nationals now constitute a third of the graduate students in many university research programs, and it is my own belief that the percentage is very much higher in graduate programs in the less prominent universities. Unfortunately, from my perspective, the report lists support for graduate research assistance as a third priority for research after equipment and facilities and following, of course, funding for direct research grant activity. I would place the need for graduate assistance support much higher on the list of national priorities.

The GAO report also does not emphasize that the talent stream for research from middle school forward is drying up. Student attainment in mathematics and science beginning in the eighth grade is grossly inadequate. The fact is that no university can sufficient reverse science and mathematics deficits that have accumulated in students throughout middle school and high school in order to prepare such students for the Nation's research enterprise.

In addition, the economics of graduate research training is a deterrent. A student who graduates with a bachelor's degree in any of the so-called hot areas of engineering now commands an entry level salary of $26,000 to $32,000 in industry. Graduate assistants typically are paid only between $9,000 and $13,000 in most of our research universities. The student who attains a doctorate in engineering and goes in to university teaching and research will probably not be paid much more in his/her first position than the entry level bachelor's candidate makes in the first industrial position.

Yet a new faculty member has borne 4 years of education expense and has foregone 4 years of substantial income. Moreover, the long-term increase in salary is substantially greater in the private sector than in university life or other research enterprises.

The economics of building a strong group of research personnel in the future in this country, has two aspects. There needs to be substantial additional support both in numbers and in the amount for stipend, for graduate research assistantships in science, mathematics and engineering. The national Government plays a crucial role in this. It should reinstitute programs that we once had to educate students in science, mathematics, and engineering by providing competitive fellowships and assistantships. In addition, funding for assistantships should be viewed favorably, and even encouraged, in funding of grant applications by existing Federal agencies.

The second step does not principally rest with the Federal Government, but rather with universities and industries which need to build partnerships that will assure reasonably competitive salaries for those doctoral students who remain in faculties to pursue careers in teaching and research.

I would like, if I may, Mr. Chairman, to call special attention to the role that Nation's urban universities are likely to play in the Nation's developing research in the future. The fact is that there is an important shift in national demography going on that has so far not been noticed in the research enterprise. But it should be understood that the vast majority of men and women entering research careers are now partners in marriages where both spouses are pursuing professional careers. For these men and women, urban universities are especially attractive because the nonfaculty spouse is much more likely to be able to find a promising career opportunity in a major metropolitan area. The future seems to be there, Mr. Chairman, that the urban universities will be increasingly competitive for and attractive to the Nation's research personnel.

Finally I would like to comment on what I believe to be the relationship between the training of graduate research personnel and the problem of the preparation of young people in middle school and high school who are being prepared in science and mathematics. I don't foresee, as the president of a large university in a large urban center, any prospect whatsoever that the deficiencies in teaching and science and mathematics in public schools are going to be reversed in the foreseeable future. There aren't enough teachers graduating and the teachers that are graduating in those areas spend only a short time in the schools and then go on to other work. Certainly employment in the schools in our major cities at this time is not likely to attract teachers in science and technology. It is my belief that a program of Federal intervention in the area of graduate student research personnel might also assist us to reverse the deficits in science and mathematics in our urban schools. Programs which provide fellowships, or scholarships, or assistanceships for students, graduate students in science, engineering and mathematics in the urban universities might also have as part of their obligation, for 1 year, perhaps, of the 4-year doctoral program, an assignment to assist the teachers in science and mathematics in the public schools in our large cities. We would thus be able to combine, I believe, an address of the problem of preparing

research personnel in the universities with an address of the problem of assisting youngsters starting in middle school to develop those skills in science and mathematics that will in turn make them eligible to join the ranks of researchers in our country.

I want to say, Mr. Chairman, that I appreciate the opportunity to appear. I want to thank you and the task force for commissioning the GAO's studies of research in our universities. The conclusions of the current report that we are commenting on today are plainly correct. The national Government's support for research in our universities has become a smaller proportion of overall university funding, and is probably inadequate to sustain a high level of national research at this time. In addition, I would like to urge the task force to consider the special potential and needs of urban universities located in our great manufacturing centers and to give substantial emphasis in its report to programs that train personnel for the national research enterprise.

I have not read my full statement; but it is available. I have tried to summarize it so that I could be available for questions and to make time for the other witnesses, Mr. Chairman.

[The prepared statement of Dr. Adamany follows:]

TESTIMONY OF DAVID ADAMANY, PRESIDENT, WAYNE STATE UNIVERSITY

Mr. Chairman, it is a privilege for me to have the opportunity to present testimony before this Task Force in response to the General Accounting Office's report entitled "University Finances—Research Revenues and Expenditures."

The GAO's report is impressive. Most of us in higher education would agree that it generally reflects university research revenues and expenditures, together with the Federal Government's role in promoting research. In my testimony today, I will focus on the special research opportunities of the Nation's public urban universities and on the growing problem of research manpower in the United States. In addition, I would like to make a brief comment on the special problems facing research universities in the Nation's manufacturing heartland—the so-called "rust belt."

Before making those policy comments, I would like to supplement the GAO report by providing a brief overview of research at Wayne State University. Our institution is among the population of institutions from which the GAO drew its sample of twenty-eight research universities to study. That is, Wayne State University each year ranks on the National Science Foundation's list of the top 100 universities in expenditures on research.

As an urban university, Wayne State does not have the advantage of receiving Land Grant research funds. Nine of the 18 public universities studied by the GAO did receive such funds. These institutions plainly have certain advantages in building their research programs, since they receive not only Land Grant funds but also State matching funds as required by law. Nonetheless, it is impressive that a considerable number of the top 100 research universities in the United States have attained that ranking without the benefit of Land Grant funds.

I respectfully call attention of members of the Task Force to the current discussions in Congress about renewal of the Higher Education Act. Title XI as recommended by the House of Representatives continues authorization for the Urban Grant University Act. The Senate would delete this title, and the difference is being discussed between the two houses. Although the Urban Grant University Act has not been funded, and those of us in urban universities do not anticipate funding during this period when the National debt is being brought under control, continued authorization of the Urban Grant University Act is important for the future. It would strengthen the research mission of the Nation's urban universities. It would also promote applied research, which is one of the areas identified in the GAO Report as worthy of additional attention.

At Wayne State University, we estimate that when the 1986 fiscal year closes, we will have had revenues of approximately $240 million. Although we have one of the Nation's largest medical schools, we do not operate a hospital; and auxiliary enterprises are a small proportion of funds (about $11 million) in an urban university.

Hence, the principal components of our budget are spent for instruction, research, and other operating expenses.

We anticipate that total research expenditures will be between $26 and $28 million, or about 11 percent of total University spending. This is a smaller research program than in the universities studied by the GAO, but many of those institutions had substantial Land Grant funds. Approximately 65 percent of Wayne State's research funds are obtained from the Federal Government, while another 14 percent comes from institutional funds. Foundations and similar sources provide about 12 percent of research funds and industry accounts for about 5 percent.

From 1980 to 1985, the Wayne State University budget increased about 27 percent. Our Federal funds for research increased 28 percent, indicating our increasing competitiveness for research funds. And our total research funding increased about 34 percent. This is a picture, we believe, of a vital and competitive research enterprise.

Despite our University's increase in federal research funds in recent years, there is a strong feeling that the Federal Government is diminishing its commitment to the Nation's research effort. This is surely reflected by the GAO Report's finding that Federal grant and contract activity is a declining proportion of institutional revenues in its sample of 28 research universities. This decline in Federal funding will inevitably weaken the Nation's total research effort and place us at a disadvantage in international affairs.

We cannot expect the States to make up for the loss of research funding from the Federal Government. In Michigan, our universities were seriously damaged by the prolonged, deep recession of 1980 to 1984. The past several years, the State government has made an extraordinary effort to rebuild Michigan's colleges and universities. As part of the rebuilding process, more than $25 million was allocated for research related to economic development. For our University, this means the commitment of $4.4 million to three special research centers.

At the same time, the University is increasing its commitment of institutional funds to research, as I previously noted. We have increased our total spending from State appropriations and from private gifts for research. In addition, we have attempted to reinvest Federal indirect cost funds in the University's research program. Forty-two percent of indirect cost recovery received by the University, up to $4 million, is directly reinvested in research activity. And all indirect cost recovery received in excess of $4 million is directly reinvested in research. These investments of indirect cost recovery help stimulate and support research in areas that are not currently favored by the Federal Government, foundations, or private industry. They therefore serve the purpose of preparing the research groundwork for areas that now have lower priority but may in the future have higher priority. In addition, indirect cost funds are used to purchase and maintain equipment, support technicians, and meet other costs that are not covered by the direct costs of Federal grants.

The very best efforts of the State government and the University will not compensate for a withdrawal of Federal funds or any major change in the longstanding federal commitment to research. Indeed, it would be a substantial change in national policy for the Federal Government to diminish its commitment to research with an expectation that the States and universities will undertake the cost of research.

During the period since World War II, the national Government and the States have developed a partnership in the funding of higher education. The States generally provided the funds for instruction, for teaching and research support (such as computing and libraries), for other operating expenses, and for most facilities. The national Government has made its commitment in two important areas: student financial aid to promote equal educational opportunity, and research. In the category of research, the national Government has in times past provided some funds for research facilities and for research libraries. Unfortunately, those programs have been largely discontinued. A withdrawal of support for research activity itself would represent a significant shift in national policy and would leave the Nation's research community without a major source of governmental support.

I would like, Mr. Chairman, to take a few moments to comment on two special aspects of the national research effort. First, I would like to call attention to the problem of research funding for those technologies that bear most heavily on the nation's heavy manufacturing industries. In 1984, the Office of Technology Assessment issued a report entitled "Computerized Manufacturing Automation." The report noted the surge of automation that will occur in the manufacturing industry. It pointed out that the greatest early impact of automation would be in the East North Central States (especially Illinois, Michigan, and Ohio) and the Middle Atlantic States. And it called attention to our lack of preparation for the surge of automa-

tion in manufacturing. Workforces are not sufficiently educated to meet the new demands of manufacturing plants. And the Nation's applied research in programmable automation was deemed deficient for international competition. There is no doubt that American industry is now investing heavily in both applied and basic research in this area. Many universities are also doing so. The Department of Defense has increased its commitment to research in some areas related to manufacturing automation, such as artificial intelligence and machine vision. But the fact remains that the United States remains substantially underinvested in research that will allow our manufacturing industries to become more competitive in cost, production quality, and total output. Unless this Nation is indeed going to follow a policy of deindustrialization, allowing heavy industry to go offshore, there is an urgent need for a partnership between the national Government, industry, and the universities to expand basic and applied research in all aspects of programmable automation and machine inteliigence.

I would especially call attention, Mr. Chairman, to the implications of research in programmable automation and other industry-related applied research for our urban universities. Most production facilities as well as the research divisions of major manufacturing corporations are located in the Nation's large metropolitan areas. The Nation's urban universities are natural partners for these industries. We already train most of their engineers and many of their other personnel. Many of our faculty members have some consulting or research relationships with these companies. Many of us already have joint research projects with industry in our area. The urban universities are especially able and are, on the whole, very willing to expand these applied research relationships with industries in their communities. National policy should give substantial encouragement to these efforts.

Second, Mr. Chairman, is the pressing issue of research personnel. The facts are clear enough. The United States is headed for a dramatic shortage of research personnel in science, engineering, and mathematics. This shortage will occur at just the time when University faculty members in these areas will be retiring in large numbers, when industry will begin to reinvest in basic research, and when the national Government will be financially capable of greatly expanding its research commitments. The GAO report identifies a concern by the universities about the lack of adequate financial support for graduate research assistants. It notes also that foreign nationals now constitute a third of the graduate students in many university engineering research programs; and it is my own belief that the percentage is much higher in graduate programs in the less prominent universities. Unfortunately, the report lists support for graduate research assistants as a third priority, after equipment and facilities. I would place this need higher on the list of national priorities.

The report also does not emphasize that the talent stream from middle school forward is drying up. Student attainment in mathematics and science beginning in the 8th grade is grossly inadequate. No university can sufficiently reverse science and mathematics deficits that have accumulated in students throughout middle school and high school in order to prepare such students for the Nation's research enterprise.

In addition, of course, the economics of graduate research training is a deterrent. A student who graduates with a bachelor's degree in any of the "hot" areas of engineering now commands an entry level salary of $26,000 to $32,000 industry. Graduate assistants are typically paid only $9,000 to $13,000 in most research universities. The student who attains a doctorate in engineering and goes into University teaching and research will probably not be paid much more in his/her position than the entry level bachelor's candidate makes in his/her first industrial position. Yet the new faculty member has borne four additional years of educational expense and has foregone four years of substantial income. Moreover, the long-term increase in salary is substantially greater in the private sector.

The economics of building a strong group of research personnel thus has two aspects. These should be substantial additional support—both in numbers and in the amount per stipend—for graduate research assistantships in science, mathematics and engineering. The national Government plays a crucial role in this. It should reinstitute sweeping programs to educate students in science, mathematics, and engineering by providing competitive fellowships and assistantships. In addition, funding for such assistantships should be viewed favorably—even encouraged!—in the funding of grant applications to existing Federal agencies.

Second, universitites and industry need to build partnerships that will assure reasonably competitive salaries for those doctoral students who remain in universities it pursue careers in teaching and research. There is plainly a lesser role for the national Government in this respect.

I would like also to call attention to the special role that urban universities are likely to play in the Nation's developing research enterprise. Earlier I commented that the proximity of major manufacturing industries and urban universities creates a substantial opportunity of collaboration. This proximity also make the urban universities attractive to researchers in science, mathematics, and engineering, because they recognize that the research activities of industry are closely related to their own scholarship. Beyond that, however, is an important shift in national demography that is unsettling longstanding patterns of career choice. The vast majority of men and women entering research careers are now partners in marriages where both spouses are pursuing professional careers. For these men and women, urban universities are especially attractive, because their spouses are much likely also to be able to find promising career opportunities in major metropolitan areas.

I would like also to suggest, Mr. Chairman, that the issues of training graduate research personnel and of increasing the flow of youngsters in middle school and high school who are well prepared in science and mathematics can be closely linked. This should be especially true in our urban universities. It is may belief that any new national programs to provide research assistantships and fellowships in science, mathematics, and technology should be linked to improved teaching of these subjects in our schools. A graduate student in a four-year doctoral program, who is receiving fellowship support, could appropriately be asked to devote time in one of those years to public school teaching instead of to research. This would help address the massive shortage of science and mathematics teachers in our urban schools—a shortage for which there is no solution or corrections anywhere in sight.

In summary, then, Mr. Chairman, I want to thank you and the Task Force for commissioning the GAO studies of research in our universities. The conclusions of the current report are plainly correct: the national Government's support for research in our universities has begun to diminish at time when there is an urgent need to expand rather than contract our overall national research effort. In addition, I would urge the Task Force to consider the special potential and needs of urban universities located in our great manufacturing centers and to give substantial emphasis to programs that train personnel for research enterprise.

I very much appreciate the opportunity to appear before the Task Force today.

DISCUSSION

Mr. FUQUA. Thank you very much. We will make your full statement a part of the record so it will appear in its entirety.

You mention in the latter part a very novel idea of research assistantships, teaching in high schools—mathematics, science, and so forth. I am wondering what type of problems they would encounter in getting certified or approved to teach in many of the areas even though they are very qualified in their own subject matter. Would that be a problem?

Dr. ADAMANY. Mr. Chairman, I can't speak for the other areas, but I think I can say that in all of the urban areas of the country as I know from the network of urban university presidents, we are so deficient in science and mathematics teachers that the State boards of education have already suspended the certification requirements to allow people to go into the schools who have science and mathematics knowledge in order simply to meet the classroom needs. The infusion of people who were being trained as research assistants in our universities into the schools, I believe would be widely welcomed as a counterforce to the growing inability to offer science and mathematics in the urban schools. I would see this as a package in which in a 4-year doctoral program by a student in mathematics or science, they would spend 3 years supporting the research enterprise and 1 year—instead of the half-time that devote to working in laboratories with research teams—they would spend in the public schools assisting the science and mathematics teachers there to prepare students adequately.

Mr. FUQUA. Well, it is a very worthy idea. I know we have had repeated testimony during the course of this task force about the inadequacy of the numbers of science and math teachers, certified teachers, in those subjects.

You also mention the fact that you doubted that that would improve much in the immediate future. One question that has been presented to us is maybe we should raise the requirements for science and math for entering college. I don't know whether it is the horse or the buggy that we are—whether we are in that type of dilemma or not.

Would that require high schools or local education boards then to put more requirements of science and math, if, in fact, to get admitted to colleges or universities they had to have instead of 2 years what ever it is, maybe they had to have 3 years or something?

Dr. ADAMANY. Four years ago, Mr. Chairman, we began a program of trying to educate our school boards and superintendents about the need for young men and women to be better prepared in science and math as they come to the university. When it was clear that we were getting a favorable response, we decided to tempt the parents as well by taking out full page ads in the newspapers in the area, specifically addressed to parents, so that they would give their students guidance. The minute it became apparent that we were reaching a large audience of people who felt that there was guidance needed as to what they should insist that students take, the response from the school systems was:

> If you do very much more of these we won't be able to offer sufficient classes in science and mathematics because we don't have the teaching personnel; we would love do it; we are committed to doing it. But the fact is that we don't have the capability of doing it.

We have, therefore, hesitated in a plan to insist on more science and mathematics for entry level into the university on the ground that the public schools systems, especially in an urban area, would not be able to fulfill that obligation, and youngsters would then be kept out of the university where at least we can provide them some remedial assistance and try to get them back on the track in science and mathematics. Unless we solve the problem of teaching personnel, there is no point in raising admissions standards in the colleges.

Mr. FUQUA. Well, a very good point; and that has been raised. And the fact that the students are 13, 14, 15 years of age. When I was in school, I probably had a lot of other things on my mind other than science at math at that age.

Getting to another part of this study, and as a university president and having also sat on the other side of the table as an administrator of funds and also raising the revenue, it gets back to this problem of funding university research through the direct and indirect cost. Is that fundamentally sound or should we look to more long-term type funding such as block grants, or fixed price system, or some other method of funding?

Dr. ADAMANY. Well, let me address first the value of the present system of competitive grants without saying that it should be the only device that we should use. It has this great advantage; it does

mean that the most able scientists are able to get support for their work.

We should recognize that in every intellectual enterprise the work of the 10 percent of the best people causes greater gains to occur than the 50 percent of the least able people. So we want to focus our resources in areas of talent and accomplishment, and the present competitive grant systems by most of the research agencies help us to do exactly that.

Having said that much, let me say that in some areas there are other methods of making commitments that certainly have merit. The allocation of funds by formula or grant for facilities and equipment, which allow the ablest people to the work is highly desirable.

The Federal Government, has in the past, shown an ability to develop what I think are acceptable formulas for the allocation of funds. The more difficult question, Mr. Chairman, is whether there can be longer term commitments. The science enterprise sometimes moves with remarkable and surprising alacrity; sometimes it is a slow and painful process of discovery.

I do not know of a funding mechanism that would be available to the Federal Government or to the State government, for that matter, that could assure long-term to the support of particular research enterprises, in particular, institutions.

I believe that the stability of long-term funding is important, but the authority of the Congress and the executive branch, and in our States, the governor and legislature to change policy direction in the enactment of appropriations measures, really makes it very difficult to anticipate how stable long-term funding commitments could be made.

Mr. FUQUA. As is currently in the circular A-21 regulation, there has always been a certain amount of friction between the administering agency and the recipient group; that it was unrealistic in certain areas; it didn't allow for real costs.

The arguments on the other side are "Yes, we have; and you haven't been attentive to the fact that we did include replacement costs, but you have never used replacement costs, you have gone ahead and spent it". What is your opinion of that situation?

Dr. ADAMANY. I suppose we will never settle the question of indirect costs——

Mr. FUQUA. We haven't in 24 years.

Dr. ADAMANY [continuing]. And let me say, Mr. Chairman, that the assessment of what the indirect costs are is invariably an imprecise business; and cost accountants themselves are not going to agree on this fully.

I believe that the Federal Government's indirect cost policies have in general been beneficial to universities. I think the institutions have followed varying strategies. And perhaps the proper response to your question is to give you two illustrations from within our own State.

The University of Michigan, for example, takes very seriously the replacement cost of facilities aspect of indirect cost and actually sets aside 25 percent of indirect cost recovery into the plant fund for the renewal of laboratories.

In our institution we do not do that. We have chosen instead to distribute, as the GAO report says, to distribute the indirect costs

largely to the research scientists and the research schools and colleges on the ground that they are bearing a heavy administrative cost for carrying out research.

It turns out that most of them are so committed to the scientific enterprise that they are prepared to reinvest the indirect costs back into the research enterprise, usually in the form of equipment or technical personnel. And what that has done in our institution is to vastly improve the quality and the scope of the research enterprise.

Is the Michigan format more nearly correct; or is ours more nearly correct? Both of them have had the impact of greatly improving the research enterprise in those respective universities. We then then, of course, accept that the maintenance of facilities and the restoration of equipment falls upon the general fund budget of the university, and we have not complained that the indirect costs are inadequate.

I think what we can't do as universities is have it both ways. We can't reallocate the indirect cost and then complain that we are not replacing the scientific facilities.

But the discretion that we have been given by the Government in allocating those funds either to the facility's maintenance or to the stimulation and expansion of the research program, has been a boom to the universities, I hope that the regulatory instinct that lurks in agency—and as the head of an agency, it lurks in our agency as well and the university—will not too much restrict our opportunity to make suitable investment at the university level of the indirect costs.

I think the indirect cost program has been valuable and I do not complain about the level of the cost. I would be very regretful if the present drive in the executive branch to eliminate what is called the administrative share of indirect costs, if that were successful, would really eliminate a significant part of the discretion that we have to make research investment with these funds.

Mr FUQUA. Thank you.

Mr. Fawell?

Mr. FAWELL. The only question I have is in regard to the lack of math and science teachers in the elementary schools system, and high school. What about the talent that is in industry and the possibility of their being given leave of absence, for instance, to go in and doing teaching? Or a lot of the talent that, especially with women now increasingly coming into math and science? There is talent in the home, as certain women do chose to stay. Has there been much of a study in that regard to see what type of talent we may have in our communities that are not being used?

Dr. ADAMANY. We have a series of experiments going around the country in which industries are adopting schools. One industrial enterprise will adopt one school in the community and attempt to assist them. What we discover is that industry's concern about the quality of elementary and secondary education is very high. They are willing to make significant investments to assist those schools. As it turns out, however, the thing they are most reluctant to do is to share their most talented people on any full-time basis, because industries, like universities, find that the number of talented people who can make significant contributions in the industrial re-

search or applied research enterprise, is a relatively small number. So the release of people into the public schools has not been part of these programs even though it has been suggested.

Mr. FAWELL. What about school boards head-hunting? There are people who are a little bit tired, you might say, of the rat race in competitive industry, and after having savored that for a while, they are perhaps ready. Something like this is being done: school boards going out and trying to compete. More and more with all the reports which are critical of public education, we are recognizing that differentials in pay rates are in order, and that being the case, perhaps, the school districts themselves can go out and do some competitive head-hunting, or entities that can do the head-hunting for them.

Dr. ADAMANY. I share your review that we are not going to resolve this problem until we are prepared pay salaries that are competitive, and competitively different for persons in different areas of the teaching enterprise. Those of us at universities where our faculties are unionized wage a war every single year to assure that we can maintain differences in salaries, both in terms of merit pay, and differential schedules for the different disciplines. In the universities we have in general succeeded because of the culture of universities. I think that there are very few school systems which could successfully negotiate such contracts with their teacher's unions in the present circumstances.

Mr. FAWELL. You haven't seen that occurring anywhere?

Dr. ADAMANY. I have not seen it occurring anywhere.

I think the question is whether we could cannonize or damn the first school superintendent who took a year-long strike in order to insist on differential pay levels for teachers in science and technology.

Mr. FAWELL. It is beginning to occur to a very small degree, I think, simply because of the great amount of criticism of the public schools, which at times is an overkill. As I sit on Education and Labor, I see the beginnings of a recognition that there will have to be differentials in pay scales. I was just wondering if you had seen anything like this occurring?

Dr. ADAMANY. If it is beginning, it is beginning in such a small way and in sufficiently small number of places that it is unlikely to overtake the need that we have for very rapid change in the way we are teaching science and mathematics to youngsters beginning in middle school and before. I am not optimistic that we are going to very rapidly go that way.

I do want to say, however, in recognition of the discussions in some of the teacher's unions that at the national level there has been some discussion of systems of master teachers that would allow a significant higher pay level for those who are certified as master teachers, including science and technology. And there is some recognition of the possibility of differentiation. I think it will be a while before that takes hold as an idea, nationally.

Mr. FAWELL. Just one last word. I have had advisory committees in my congressional district. I have one in science and technology, and I am amazed—of course in my district, the western suburbs of Chicago—there is just a tremendous number of talented people who are for one reason or another not active in the business world

at this time, as the word became known that I was looking for talented people here, they came from all over.

I just can't help and believe that if school districts really began to assert themselves and go out looking for these people, they will find them, at least in the urban areas—perhaps not in the more rural areas—but in the urban areas I really believe they are there and for one reason or another, inactive at a particular time, and possessing the talents. Although, as the chairman has pointed out perhaps not certified, by all the rules and regs that a State school superintendent might have. But those are going by the boards I think, and people are now beginning to recognize that that talent has to be invited in.

Thank you.

Dr. ADAMANY. Thank you.

Mr. Fuqua. Mr. Lujan?

Mr. LUJAN. Let me followup on that a little bit. That was not going to be my line of questioning, but it is an interesting one.

I have noticed at home and have been somewhat critical for the universities not taking advantage of that talent that exists. Just within 60 miles of my home town, Albuquerque, there are two major national laboratories, Los Alamos and Sandia, and for some reason universities—and it is not just limited to the university here in New Mexico, it is the same with Livermore and some of the others—do not tap that talent.

Oh, some attempts are made at it. You know, somebody that is particularly close to the university, that happens to head one of the departments there. They will have him come in and teach a course. So they will get 30 kids from the university to work there during the summer; just little tiny attempts.

What can we do to encourage the universities to do the things that Mr. Fawell is talking about, to get them to take advantage of that talent that is there?

We probably could get it for free, or very little cost. Certainly the cheapest way is to attract people that are already trained and experts and involved all day long in that particular technology. What can we do to have universities take advantage of that?

Dr. ADAMANY. Well, certainly I can't speak for all universities, Mr. Lujan, but at our university we make a very extensive effort to recruit people, especially in areas of engineering, from the great manufacturing industries that surround us in Detroit. If recollection serves, about one-third of all of our engineering activity is taught by people who are active, either in production or research activities, engineers that are active in production and research activity, in the industries in Detroit.

We get a certain amount of complaint, of course, from accrediting societies and others about large numbers of part-time people, but we can defend that. It is more difficult to get people to come full time.

It is true that when we can identify somebody who will come full time, that industry is very often prepared to subsidize their salary in part. On the other hand, you will understand that industry is reluctant to allow its best people to leave important assignments in the research laboratories or the production enterprises on a full-time basis.

Those people themselves are reluctant to interrupt a career——

Mr. LUJAN. I wasn't thinking of full time. It would seem to me you could build a curriculum around somebody teaching two classes a week, or something like that.

The chairman has reminded me that you have got an 11 o'clock flight, so I am going to cut off my questions.

The CHAIRMAN. I apologize, I thought you had to leave here at 11. I didn't realize it was National Airport at 11.

We thank you very much for being here.

We hope your plane is a few minutes late and you that you make it.

Dr. ADAMANY. Thank you very much. I would ordinarily stay on to respond to questions. Unfortunately, we have a strike on our campus and I need to be home.

The CHAIRMAN. Thank you very much for sharing your thoughts with us.

Our next group of witnesses, as I announced at the beginning, are from the Government Accounting Office: Ms. Sarah Frazier, Associate Director of Resources, Community, and Economic Development Division; and Dr. Mark Nadel, Group Director of Resources, Community, and Economic Development Division.

These were the people responsible for the report that we have before us.

Ms. Frazier, we would be happy to begin with you this morning. We thank you for being here and also for the very fine report that you have given us.

Mr. LUJAN. Mr. Chairman?

The CHAIRMAN. May I ask unanimous consent to include a statement in the record.

Mr. LUJAN. Without objection, Mr. Lujan's statement will appear after my opening statement in the record.

Ms. Frazier.

STATEMENT OF SARAH P. FRAZIER, ASSOCIATE DIRECTOR, RESOURCES, COMMUNITY, AND ECONOMIC DEVELOPMENT DIVISION, U.S. GENERAL ACCOUNTING OFFICE, WASHINGTON, DC, ACCOMPANIED BY DR. MARK NADEL, GROUP DIRECTOR, RESOURCES, COMMUNITY, AND ECONOMIC DEVELOPMENT DIVISION, GENERAL ACCOUNTING OFFICE

Ms. FRAZIER. Good morning to you and to members of the committee.

We are pleased to be here today to discuss our recently issued report, "University Finances: Research Revenues and Expenditures."

With me today, as you noted is Dr. Mark Nadel, who directed this work.

I would like to present a summary of my statement and submit the entire for the record, if I might?

The CHAIRMAN. Yes; we will make the entire statement part of the record.

Ms. FRAZIER. Thank you.

Because the United States relies on universities for the training of scientists and engineers and for half of the Nation's basic re-

search, the financial condition of these institutions and their capacity to carry out their missions are of vital concern. Our report examined how Federal funding for research fits into the total finances of a random sample of 28 major research universities between 1975 and 1984.

In brief, we found that because Federal support for universities increased at a slower rate than other revenues between 1975 and 1984, the Federal Government ended up providing a smaller portion of university research revenues, overall operating revenues, and physical plant funds at the end of this period. Tuition and fees, auxiliary university sources, and private sources provided an increased share of university revenues. We also found that major differences existed between public and private universities' funding sources.

Federal funds still accounted for about two-thirds of university research revenue. Although industry funding of research more than doubled in constant dollars from 1975 to 1984, it still accounted for less than 6 percent of research revenues for both public and private universities.

In order to describe more of our findings, let me first speak about the overall trends for university revenues and expenditures. Overall during this period university operating revenues and expenditures increased faster than the rate of inflation. The research universities in our sample increased their operating revenues on average by 37 percent, from an average of $284 million per university in 1975, to an average of $389 million in 1984. Education and general revenues increased 25 percent, while auxiliary and other sources of revenue increased 66 percent.

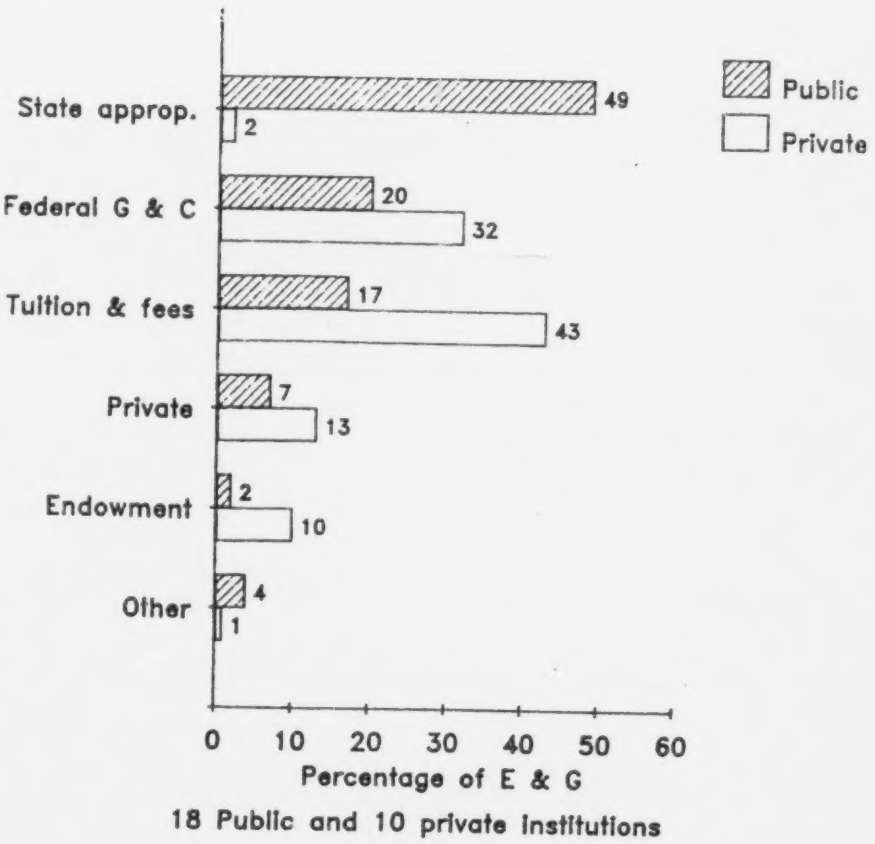
Tuition and fees was the fastest growing portion of of educational and general revenues, increasing 48 percent from 1975 to 1984, for overall sample. In contrast, Federal grants and contracts, including research and student aid, was the slowest growing component at 8 percent.

The proportion of all educational and general revenue provided by the Federal Government has decreased for both public and private universities. For public universities, Federal funds decreased from 26 percent to 22 percent, while for private universities, Federal funds decreased from 36 percent to 32 percent. As this indicates public and private universities received significantly different portions of their educational and general revenues from different sources.

Let me direct your attention to figure 1, which appears on page 5 of your statement. As that shows in 1984 public universities depended on State appropriations for almost half of their educational general revenues.

Figure 1

Sources of Educational and General Operating Revenues, Public and Private Universities[a] (1984)



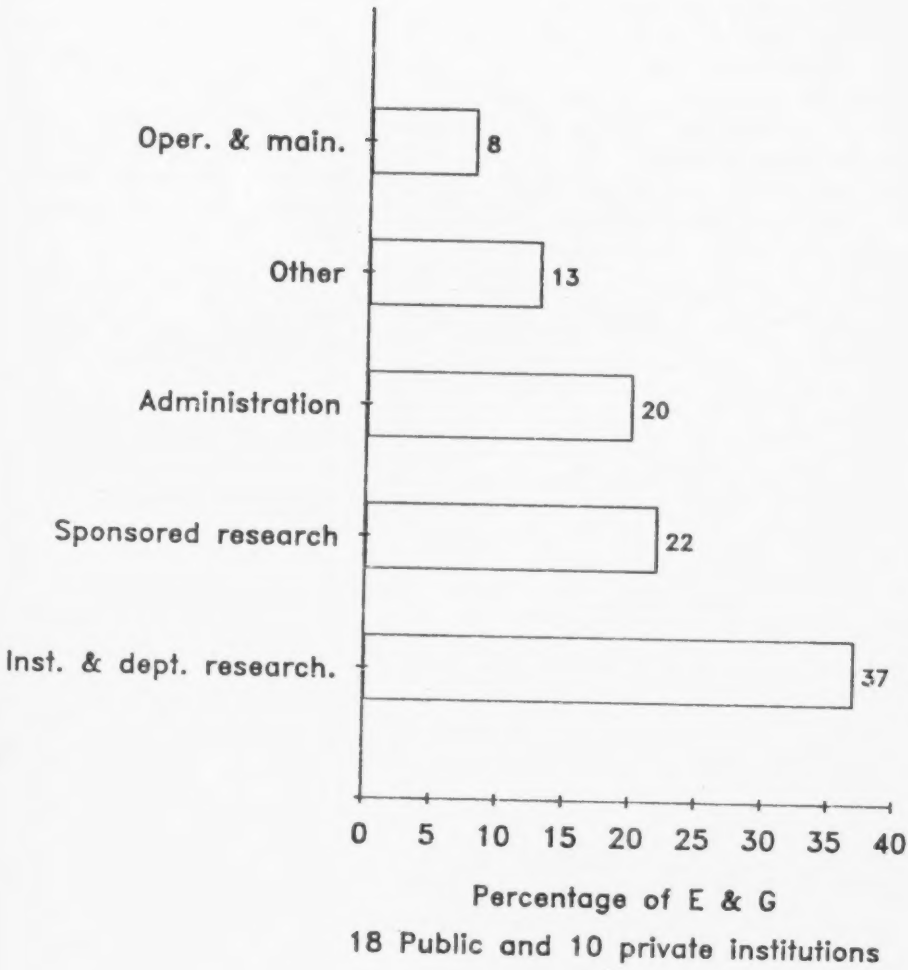
[a]Percentages do not add to 100 because of rounding.

Private institutions, which receive little State support, relied on tuition and fees for 43 percent of their educational and general revenues. In addition, tuition and fee revenue of private institutions increased significantly faster than for public institutions during this period.

Now let me discuss overall educational and general revenues. I have included in our statement figure 2, which appears on page 7 of the statement.

Figure 2

Educational and General Expenditures
(1984)



18 Public and 10 private institutions

Mr. Lujan, I am referring to the statement, perhaps you have a copy of that; and not to the report. I was trying to make it easier and I made it harder. In the statement it is numbered slightly differently.

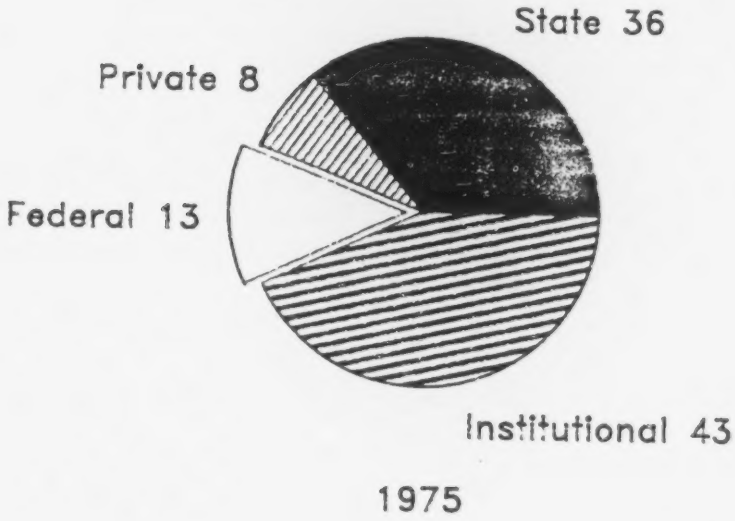
It shows that direct costs for instruction and sponsored research represented by the bottom two bars on that chart, account for almost 60 percent of educational and general expenditures in 1984.

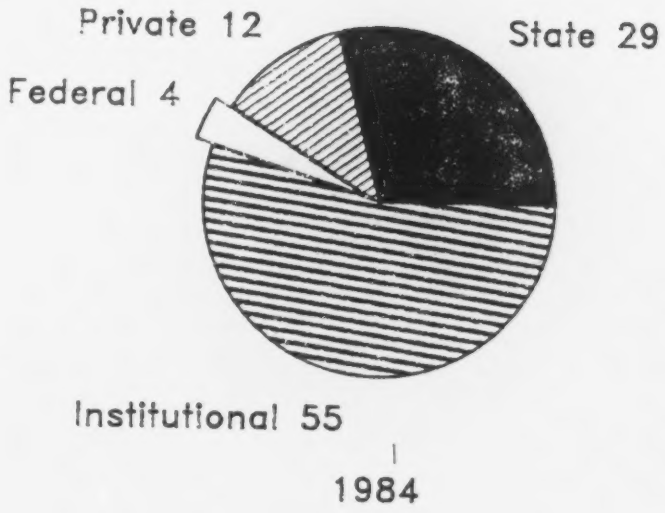
Of concern to this committee in previous hearings has been the adequacy of scientific facilities in universities. These facilities are included in our physical plant category. In current dollars, universities increased their physical plant book value on average of about $20 million annually from 1981 to 1984. The research facilities share of the annual increase ranged from 10 to 33 percent.

We have included in the statement as figure 3, which is on page 8 of the statement, several pie charts which show that Federal and State revenues as proportions of physical plant revenue decreased from 1975 to 1984, while private gifts and institutional sources rose.

Figure 3

Sources of Physical Plant Revenue[a]
(1975, 1984)





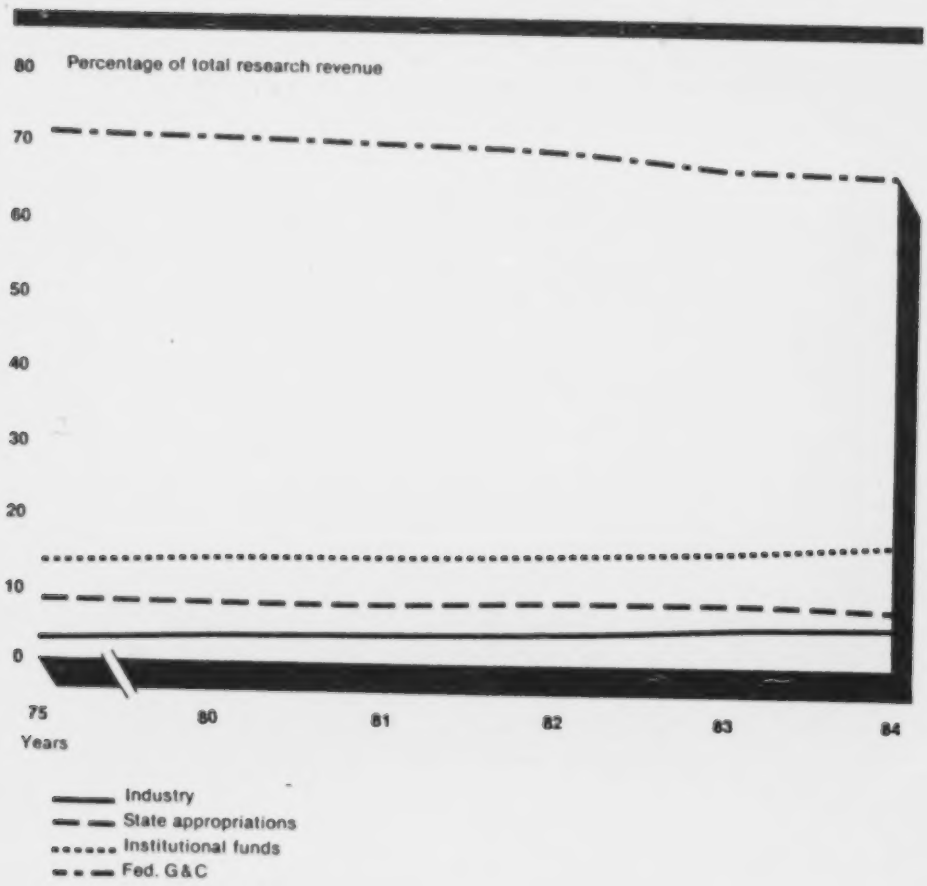
10 Public and 8 private institutions

[a]Sources are reported as percentages.

Let me now move to revenues for research and development. At a time of increasing costs of scientific research and tightening budgets, this committee and others have expressed concern over trends in research revenues and the composition of those revenues. We found that the Federal Government continued to be the dominate provider of research revenues in 1984, accounting for over two thirds of the funds. Average Federal funding rose from $41 million to $50 million for institutions. However, the growth in Federal funding increased more slowly than most other sources, resulting in the decline in the Federal share of research revenues, from 71 to 66 percent. Average industry funding more than doubled, from $2 million to $4.5 million per institution. However, as stated earlier, in 1984 industry funding still only amounted to about 6 percent of overall research revenue.

Figure 4

Research Revenues by Source
(1975, 1980-84)

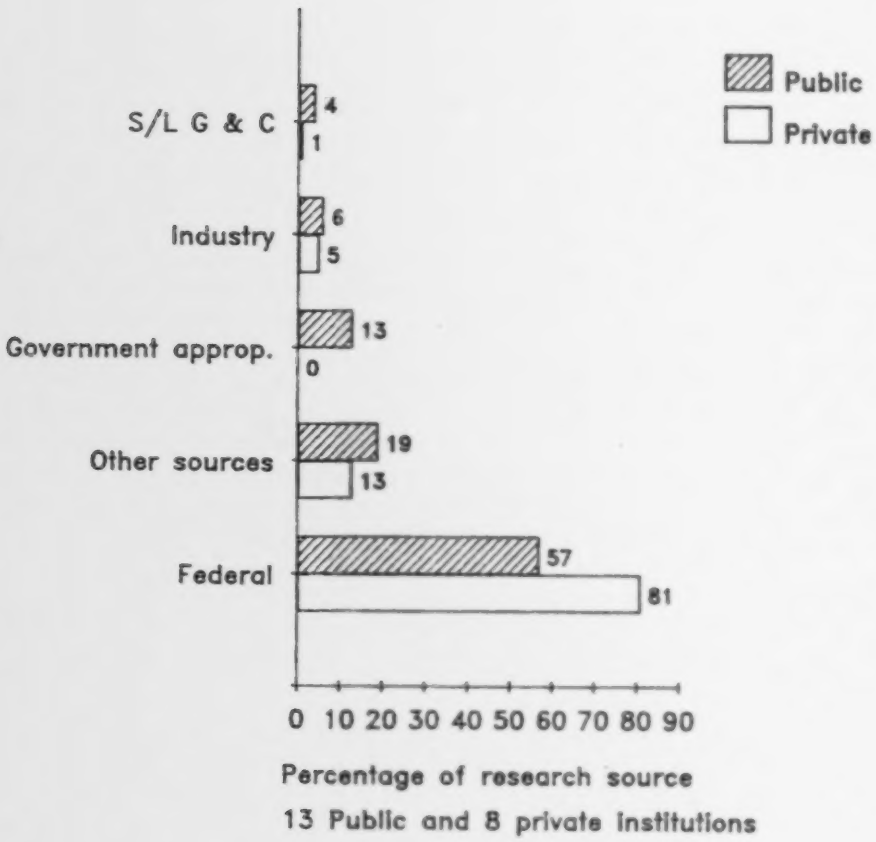


13 Public and 8 Private Institutions

Another figure included in the statement, figure 5, is on page 12. It shows that private universities received a greater portion of their research revenues from the Federal Government than did the public university. This has been traditionally so.

Figure 5

Research Revenues for Public and Private Universities[a]
(1984)



[a]Percentages do not add to 100 because of rounding.

For 1984, Federal grants and contracts made up 81 percent of private universities' research funds, and 57 percent of public universities. On the other hand, the public universities draw on Government appropriations and other sources of institutional funds for a greater portion of their research.

Another area of interest and of some controversy is indirect costs for research and development. Indirect costs, as you know, support research but cannot be specifically attributed to individual projects. Indirect cost rates for federally-funded research are developed and negotiated in accordance with circular A-21.

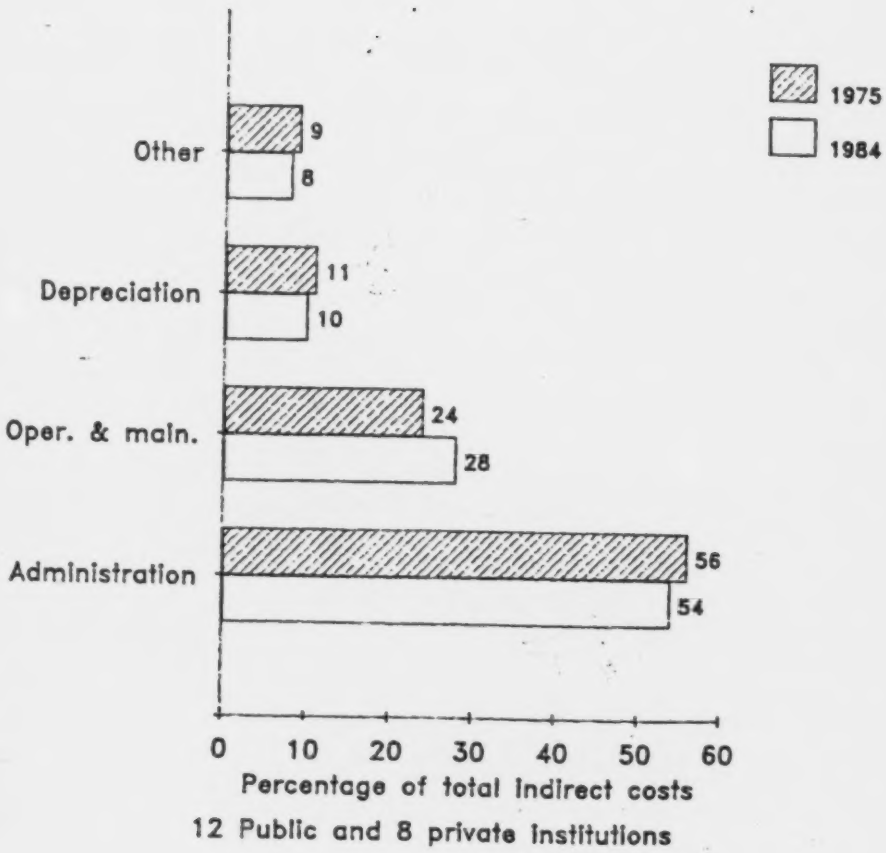
For the institutions in our sample we found that indirect costs, as a percentage of each Federal research dollar, rose from 22 percent in 1975, to 26 percent in 1984. Public institutions' overall level of indirect costs remained at a relatively constant 20 percent. Private institutions' indirect costs rose from 24 percent of the Federal research dollar in 1975, to 31 percent in 1984.

We also found that the Federal Government pays a higher proportion of research support as indirect costs than do other sponsors of university research. In comparison with the Federal Government's 26 cents of indirect costs on the research dollar in 1984, indirect cost accounted for 14 cents of every industry research dollar and 7 cents of every State research and development dollar.

We have included figure 6, on page 14 of your statement, to show administration accounted for the largest amount of indirect costs; about 55 percent of Federal reimbursements for the 20 institutions that reported these data to us. It may be of note that this proportion has not changed much over the past 10 years.

Figure 6

Categories of Federally Reimbursed Indirect Costs
(1975, 1984)



12 Public and 8 private institutions

Operations and maintenance accounted for the next largest share of indirect costs, increasing from 24 percent in 1975, to 28 percent in 1984. For the public institutions the portion of indirect costs due to administration increased slightly, while it decreased a small amount for private universities.

A final area we reported on was the ability of universities to adjust to changes in the level of the Federal research funding. In response to the committee's request we interviewed senior research officials at 26 of the universities in our sample. We asked the universities about the present constraints to their research efforts. We were told that the inadequacy of both research equipment and research facilities were the leading constraints to their present research efforts. Inadequate research equipment was reported as a hindrance to present research by 23 of 26 universities; and inadequate facilities by 20 of the 26.

The Federal research funding which remained roughly at present levels we were told, present constraints would probably worsen if there were no additional remedies found. According to the university officials, a decline in Federal research funding would generally exacerbate present constraining factors with three kinds of likely effects. Most often mentioned was the potential need to cut back on the number of personnel employed, particularly technicians, graduate students, and young faculty. Second, present equipment and facility constraints would worsen. And third, seed money for new research would be cut.

University officials described how, in response to potential declines in Federal funding, their institutions are building on their existing or future program strengths to attract new research money. Some have identified specific fields, predominantly ones that are interdisciplinary and involved applied research, that they would like to see emphasized. Some have set up new centers or provided matching funds as inducements for faculty to target such areas as molecular biology, electronics, telecommunications, and materials.

In summary, Mr. Chairman, we found that the research universities in our samples received a smaller portion of their research revenues, overall operating revenues, and physical plant funds from the Federal Government than they did 10 years ago. This occurred because Federal research support increased at a slower rate than most other sources of research revenues.

For public universities Federal funds still accounted for over half of the research revenues. For private universities the Federal Government provided about 80 percent of the research revenue.

This concludes my statement. We will be glad to answer any questions that you may have.

[The prepared statement of Ms. Frazier follows:]

United States General Accounting Office
Washington, D.C. 20548

FOR RELEASE ON DELIVERY
EXPECTED AT 9:30 A.M.
TUESDAY, SEPTEMBER 16, 1986

STATEMENT OF
SARAH P. FRAZIER, ASSOCIATE DIRECTOR
RESOURCES, COMMUNITY, AND ECONOMIC
DEVELOPMENT DIVISION
BEFORE THE
HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY
ON
UNIVERSITY FINANCES:
RESEARCH REVENUES AND EXPENDITURES

Mr. Chairman and Members of the Committee:

We are pleased to be here to discuss our recently issued report, University Finances: Research Revenues and Expenditures (GAO/RCED-86-162BR, July 11, 1986) that was requested by this Committee. Because the United States relies on universities for the training of scientists and engineers and for half the nation's basic research, the financial condition of these institutions and their capacity to carry out their missions are of vital concern. Our report examines how federal funding for

research fits into the total finances of a random sample of 28 major research universities between 1975 and 1984.

In brief, we found that because federal support for universities increased at a slower rate than other revenues between 1975 and 1984, the federal government ended up providing a smaller portion of university research revenues, overall operating revenues, and physical plant funds at the end of this period. Tuition and fees, auxiliary university sources, and private sources provided an increased share of university revenues. Major differences existed between public and private universities' funding sources, as we describe later.

Federal funds still accounted for about two thirds of university research revenue. Although industry funding of research more than doubled in constant dollars from 1975 to 1984, it still accounted for less than 6 percent of research revenues for both public and private universities.

In my statement, I will discuss some of our findings grouped into the following categories:

- revenues and expenditures for operations and physical plant,
- revenues for research and development,
- indirect costs for research and development, and
- perceptions of academic executives on their research capabilities under alternative levels of federal funding.

These categories and the data within them were chosen in consultation with various experts on university finances.

REVENUES AND EXPENDITURES FOR OPERATIONS AND PHYSICAL PLANT

In order to place in context the information on research finances, we first reviewed the overall trends of university revenues and expenditures. Overall, during this period university operating revenues and expenditures have increased faster than the rate of inflation. The research universities in our sample increased their operating revenues, on average, by 37 percent, from $284 million[1] in 1975 to $389 million in 1984. Educational and general revenues (contributing about two thirds of operating revenues) increased 25 percent, while "auxiliary and other sources" of revenue (accounting for about a third of operating revenues) increased 66 percent.

Educational and General Revenues. Tuition and fees was the fastest growing portion of educational and general revenues, increasing 48 percent from 1975 to 1984 for our overall sample. In contrast, federal grants and contracts (including research and student aid) was the slowest growing component, growing by 8 percent for this period.

The proportion of all educational and general revenue provided by the federal government has decreased for both public and private universities. The federal portion of public university funds decreased from 26 percent to 22 percent, while for private universities the drop was from 36 percent to 32 percent. Thus, as shown by figure 1, federal grants and

[1]All of the dollar amounts and percent changes in this statement are in constant 1984 dollars, unless otherwise noted.

contracts slipped from being the largest source of educational and general revenue for private institutions in 1975 to the second largest source in 1984, behind tuition and fees. They were the second largest source of revenue for public universities in both 1975 and 1984.

As the previous discussion has indicated, public and private universities receive significantly different portions of their educational and general revenues from each source. These differences are also shown in figure 1. Public universities depended on state appropriations for almost one half of their educational and general revenues in 1984. Private institutions, which receive little state support, relied on tuition and fees as their largest source, accounting for 43 percent of educational and general revenues. In addition, tuition and fee revenue of private institutions increased significantly faster than for public institutions.

Auxiliary and Other Revenues. Universities increased their income from auxiliary and other sources[2] at a faster rate than from their educational and general revenue. "Auxiliary and other" income rose, on average, 66 percent, increasing from an average of $82 million in fiscal year 1975 to $136 million in fiscal year 1984.

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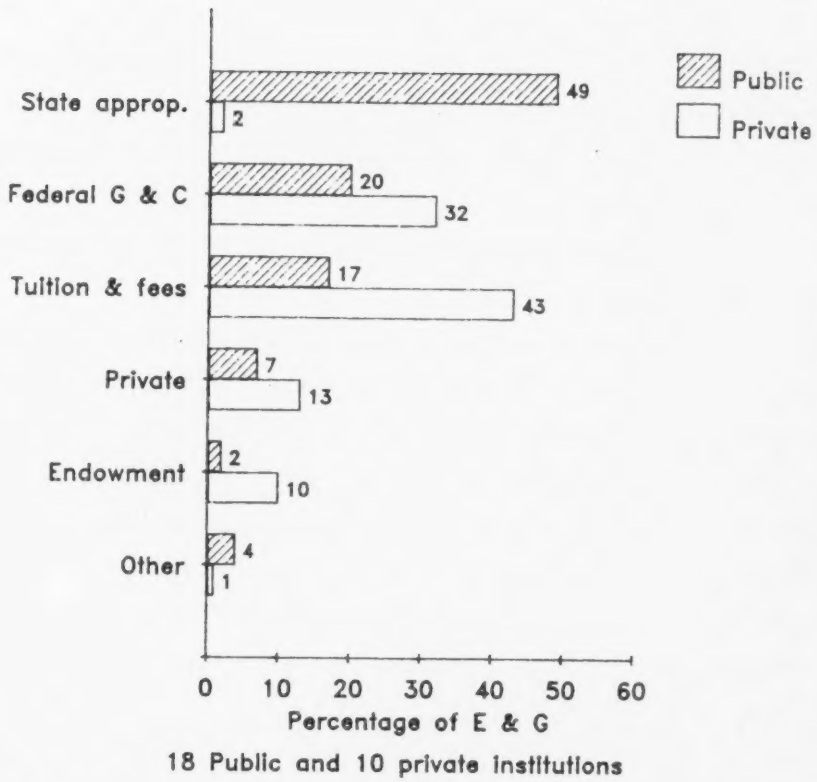
[2]This category includes dormitories, hospitals, and sales and services from other educational activities.

Figure 1

Sources of Educational and General Operating Revenues, Public and Private Universities[a] (1984)



[a]Percentages do not add to 100 because of rounding.

Educational and General Expenditures. Direct costs for instruction and sponsored research accounted for almost 60 percent of educational and general expenditures in 1984 (fig. 2). However, the shares of both of these categories declined slightly from 1975, as administrative expenditures, operations and maintenance, and the "other" category all gained a small share of expenditures.[3]

Physical Plant. As noted in previous committee hearings, there has been great concern about the adequacy of scientific facilities in universities. These facilities are included in our physical plant category. In current dollars, universities increased their physical plant book value an average of about $20 million annually from 1981 to 1984. (This increase is essentially the sum of renovation and new construction.) The share of this increase that went for research facilities each year ranged from 10 to 33 percent.[4]

Federal and state revenues as proportions of total physical plant revenue decreased from 1975 to 1984 while private gifts and institutional sources rose (fig. 3). Other institutional sources are university internal funds from unrestricted money originally given to the university from other sources that could

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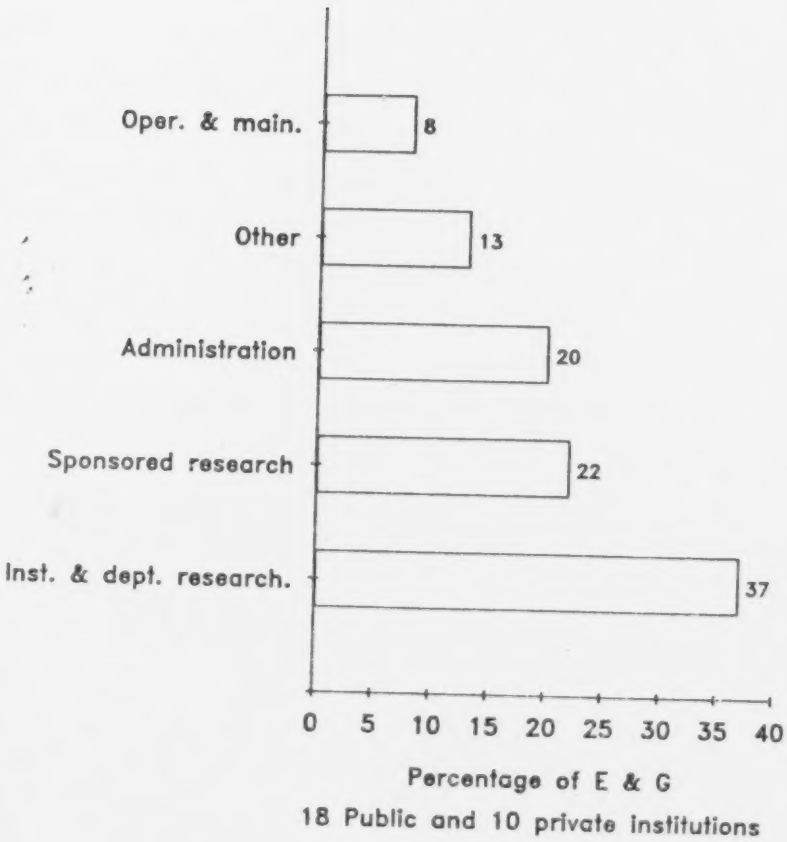
[3]The "other" category includes public service, scholarships and fellowships, and mandatory transfers, but not federally funded research and development centers, which are excluded from this study.

[4]These data are from 10 public and 4 private universities. The 33 percent increase in one year was due in part to large increases for several institutions.

Figure 2

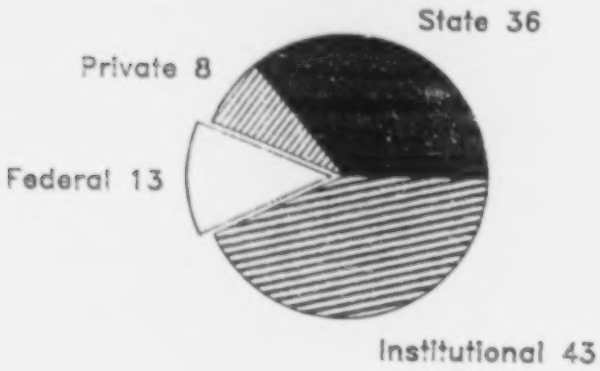
Educational and General Expenditures
(1984)



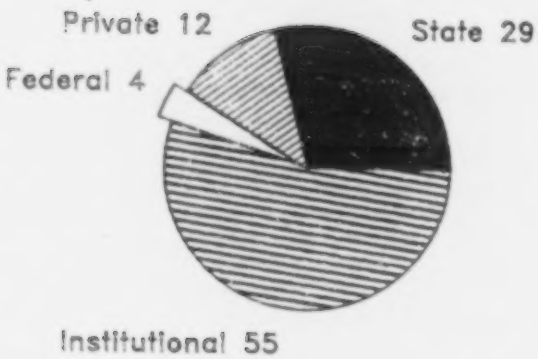
18 Public and 10 private institutions

Figure 3

Sources of Physical Plant Revenue[a]
(1975, 1984)



1975



1984

10 Public and 8 private institutions

[a]Sources are reported as percentages.

not be distinguished because of the pooling of general unrestricted operating funds.

The other institutional funds category remained the largest source for physical plant support. This category consistently accounted for about 70 percent of private universities' overall physical plant revenue while for public universities it gradually increased from 35 percent to 45 percent.

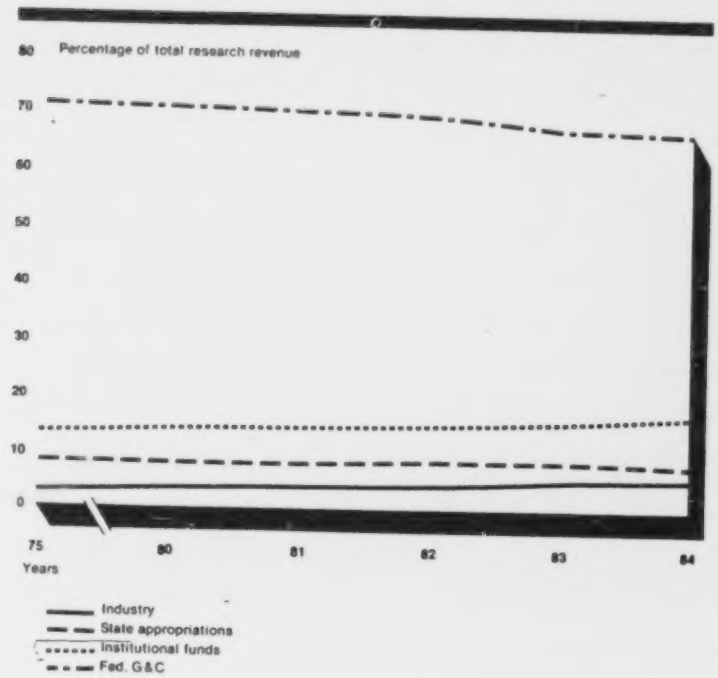
As expected, public and private universities differed significantly in the level of state support for physical plant. Public institutions received about 45 percent of their plant revenue from state sources for both 1975 and 1984, while private universities received nothing from these sources.

REVENUES FOR RESEARCH AND DEVELOPMENT

At a time of increasing costs of scientific research and tightening budgets, this committee and others have expressed concern over trends in research revenues and the composition of those revenues. The federal government continued to dominate as a provider of research revenues in 1984, accounting for over two thirds of the funds. However, the growth in federal funding increased more slowly than most other sources, resulting in a decline in the federal share of research revenues (fig. 4). Average federal funding rose from $41 million to $50 million per institution.

Figure 4

Research Revenues by Source
(1975, 1980-84)



13 Public and 8 Private Institutions

Average industry research funding more than doubled, from $2 million to $4.5 million, per institution. However, industry funding still only amounted to about 6 percent of overall research revenue in 1984.

University support for research from other institutional funds increased from 14 percent of research funds in 1975 to 17 percent in 1984. These funds may have come from various initial sources including endowment income, private gifts, foundation funds, and any other unrestricted funds.

Private universities received a greater portion of their research revenues from the federal government than did the public universities (fig. 5). For 1984, federal grants and contracts made up 81 percent of private universities' research funds, but only 57 percent of public universities'. On the other hand, the public universities draw on government appropriations (other than federal) and other sources of institutional funds for a greater portion of their research.

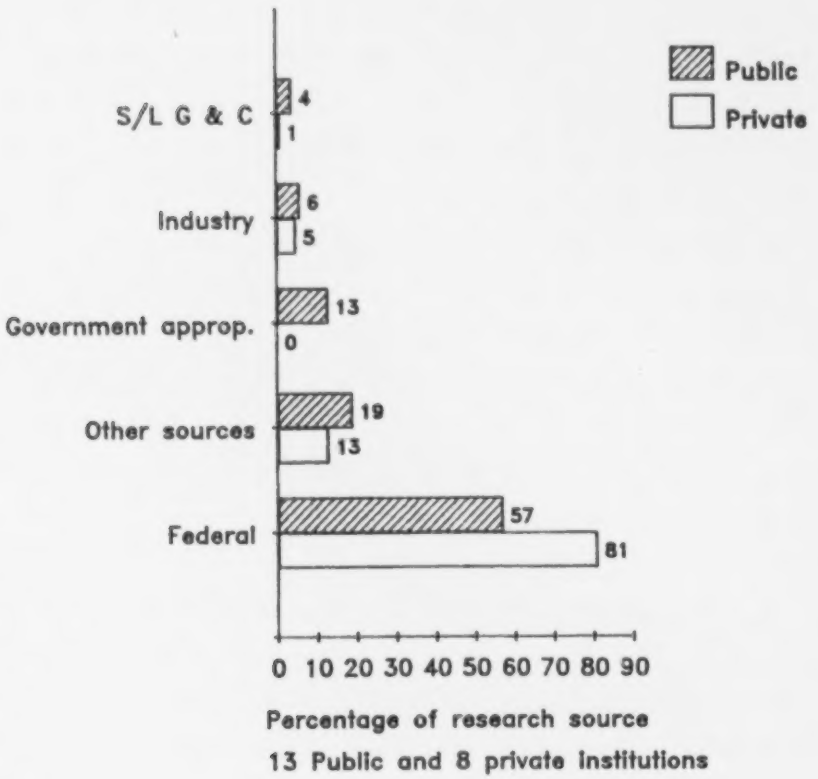
INDIRECT COSTS FOR RESEARCH AND DEVELOPMENT

The amount of and increases in indirect costs have been the subject of controversy over the past decade as critics claim that these costs are rising too rapidly and divert money from pressing research needs. University officials, in general, disagree with these critics.

Indirect costs are those that support research but cannot be specifically attributed to individual projects. These costs include categories such as administration, facility

Figure 5

Research Revenues for Public and Private Universities[a]
(1984)



[a]Percentages do not add to 100 because of rounding.

operations and maintenance, and building and equipment depreciation. Indirect cost rates for federally funded research at each institution are developed and negotiated in accordance with OMB Circular A-21. Last June, OMB published changes to A-21, placing a cap on future payments for administration overhead.

Increases in Indirect Costs. For the institutions in our sample, indirect costs as a percentage of each federal research dollar rose from 22 percent in 1975 to 26 percent in 1984. Public institutions' overall level of indirect costs remained at a relatively constant 20 percent. Private institutions' indirect costs rose from 24 percent of the federal research dollar in 1975 to 31 percent in 1984.

The federal government pays a higher proportion of research support as indirect costs than do other sponsors of university research. In comparison with the federal 26 cents of indirect costs on the research dollar in 1984, indirect costs accounted for 14 cents of every industry research dollar and 7 cents of every dollar of state government research and development support. However, experts on university finance explained to us that indirect cost reimbursements for state or industry research projects are determined differently than those negotiated with the federal government. State governments and private firms may arbitrarily set indirect cost rates or negotiate rates on a project-by-project basis.

Categories of Indirect Costs. The administrative categories accounted for the largest amount of indirect costs--from 56 percent to 54 percent of federal reimbursements for the 20 institutions reporting these data (fig. 6). This proportion has not changed much over the past 10 years. Operations and maintenance accounted for the next largest share of indirect costs, increasing from 24 percent in 1975 to 28 percent in 1984.

For the public institutions, the portion of indirect costs due to administration increased slightly, while it decreased a small amount for private universities. Public and private institutions' reimbursements for operations and maintenance showed the same upward trend, with private institutions showing a higher percentage for this category of indirect costs.

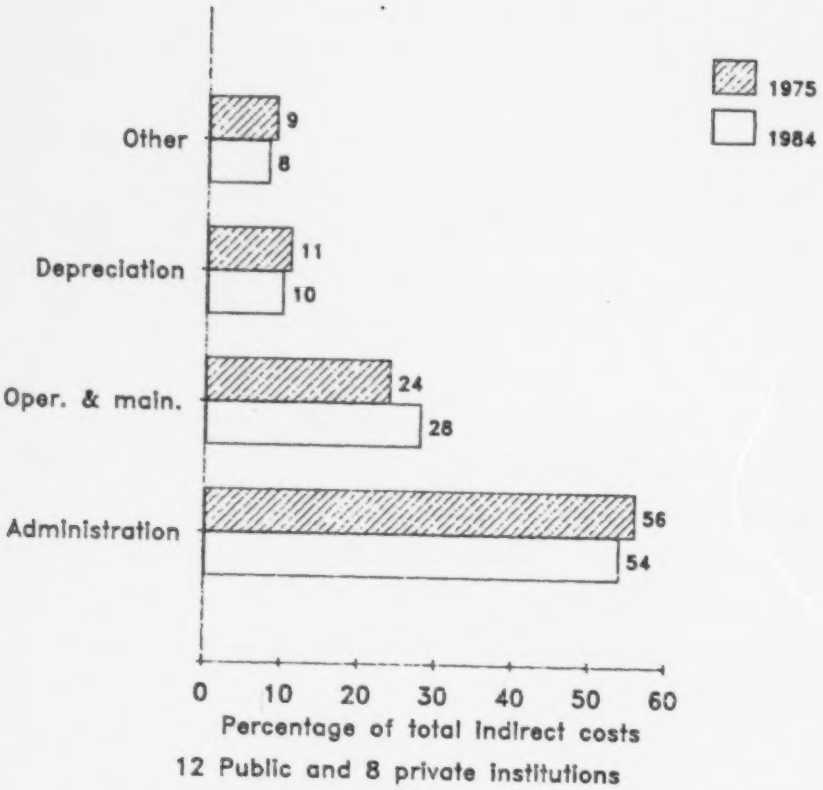
RESEARCH CAPABILITY UNDER VARIOUS LEVELS OF FEDERAL RESEARCH FUNDING

In response to the committee's request for information on how university research capability might be affected by changes in federal research funding, we interviewed senior research officials at 26 of the universities in our sample. To establish a base, we first asked the universities about the present contraints to their research efforts.

University officials told us that the inadequacy of both research equipment and research facilities was the leading constraint to their present research efforts. Inadequate research equipment was reported as a hindrance to present research by 23 universities and inadequate facilities by 20 of

Figure 6

Categories of Federally Reimbursed Indirect Costs
(1975, 1984)



12 Public and 8 private institutions

the universities. Nine universities--all public--cited difficulties in recruiting and supporting graduate students in science and engineering.

If federal research funding were to remain roughly at present levels, we were told, present constraints would probably worsen if there were no additional remedies. According to the university officials, a decline in federal research funding would generally exacerbate present constraining factors, with three kinds of likely effects:

--Personnel reallocation/retrenchment: Most mentioned was the potential necessity of cutting back on the number of personnel employed, particularly technicians, graduate students, and young faculty, since universities have commitments to tenured faculty. According to some university officials, these choices would be very difficult, since they placed great importance on the linkage between graduate education and research and the consequent need to support graduate students through fellowships and assistantships.

--Infrastructure: Present equipment and facility constraints would be exacerbated.

--Research: Seed money or "venture capital" for new endeavors would be cut.

Additionally, officials at two private institutions noted that their indirect cost rates would probably increase if their federal research funding dropped, since the indirect costs are

relatively fixed and would have to be spread over a smaller amount of federal research awards.

University officials described how, in response to potential declines in federal research funding, their institutions are building on their existing or future program strengths to attract new research money. Some universities have identified specific fields, predominantly those that are interdisciplinary and involve applied research, that they would like to see emphasized on their campuses. Some universities have set up new centers or provided matching funds as inducements for faculty to target areas such as molecular biology, electronics, telecommunications, and materials.

A small number of university officials were confident that a national decline in federal research funding would not adversely affect their institutions. They believed that they were sufficiently competitive to win an adequate amount of research funding to support their university's current or future research effort.

SUMMARY

We found that the research universities in our sample were receiving a smaller portion of their research revenues, overall operating revenues, and physical plant funds from the federal government than they did 10 years ago. This occurred because federal research support increased at a slower rate than most other sources of research revenues. Tuition and fees, auxiliary and other sources, and private sources provided an increasing

share of these revenues. Industry funding of research more than doubled in constant dollars, showing the greatest percent increase of any source of research funds. Even with this big increase, these funds accounted for only about 6 percent of research revenues for both public and private universities.

For public universities, federal funds still account for over half of the research revenues. Other major sources of research revenues are internal university funds and state appropriations. State government funds consistently provided about half of educational and general revenues and specific physical plant funding over the past 10 years.

For private universities, the federal government provided about 80 percent of the research revenue; most of the rest came from other internal funds. Tuition and fees replaced federal funding as the number one source of educational and general operating revenues. Other internal funds consistently provided about 70 percent of physical plant funds over this period.

On the basis of these data and interviews, we found that universities are capturing a greater portion of their research revenues from nongovernment sources. Changes in the portion of research supported by different sponsors could affect both the nature of university research and the support and costs of other university functions.

This concludes our prepared statement. We will be glad to answer any questions.

DISCUSSION

Mr. FUQUA. According to your report, the university revenues and expenditures have increased faster than the rate of inflation over the last 10 years. What is the cause of this trend?

Ms. FRAZIER. We found that the revenues and expenditures both had increased faster than the rate of inflation. It is difficult to pinpoint the cause of the trend specifically because it reflects a general growth and an emphasis in the society for university training and so on.

There are other sources of revenue. There has been more industry-sponsored revenue. There are a variety of different reasons. We didn't pinpoint a specific reason for it exceeding inflation.

Mr. FUQUA. Well, there is also an increase, a rather high increase in tuition and fees during that period of time. What do you predict is going to happen to that over the next 10 years; have they caught up or can you predict that tuition and fees will increase or based on the trends?

Ms. FRAZIER. Well, you are aware of the recent AEI study which talks about the fact that tuition-fee increases as paid by families proportionally does not exceed the growth of income as much as one might suspect.

However, from the university perspective, the overall increase which has been over 40 percent, as much as 60 percent for private universities and 37 percent for public, seems to have been quite substantial. Some universities have questioned whether or not they can continue to increase at that kind of rate.

The AEI study talks about price sensitivity not having been reached, apparently, for certain groups of universities. It is difficult to predict exactly at what point that might incur, but information suggests that the universities are concerned about their ability to increase tuition at high rate. They think they may have done as much of that as they can for a while. It is an area of concern, particular with the new tax bill.

Mr. FUQUA. Did you have a comment?

Dr. NADEL. No, sir.

Mr. FUQUA. Well, the indirect cost of research and development as a percentage of the research dollar has had a tendency to rise over the last few years, 25 to 30 percent. And, of course, OMB has decided to try and cap that future amount. How is this going to impact universities? Your study, I think you had 8 private schools and 10 public schools, or that reversed?

Dr. NADEL. It was mostly the public schools were the larger number.

Mr. FUQUA. What size? Were they all sizes? Did they include smaller universities or were they primarily state supported types?

Dr. NADEL. Well, the total sample was 28; and it ranged in size. But the sample was drawn from the 100 largest research universities. So, predominately, we are talking about the large research universities. We certainly had none of the small colleges in the sample.

But with regard to the question on indirect costs. The OMB, the new OMB order also reduces recordkeeping requirements insofar as the reporting of effort of faculty and deans on departmental ad-

ministration. OMB, of course, claims that will offset the revenue loss due to the cap on indirect costs.

So we are not in a position to say whether that will be a one-for-one kind of offset. It is possible that other strategies will be evolved—attempting to charge more over to direct costs, that part of departmental indirect cost which was capped was for professional salaries only; and that is capped at 3 percent. That still leaves a very large chunk of departmental indirect costs which will be done in the way they have always done, that is through negotiation.

Mr. FUQUA. Mr. Fawell?

Mr. FAWELL. Ms. Frazier, you have in the last paragraph before your summary, you have a statement that a small number of university officials were confident that a national decline in Federal research funding would not adversely affect the institutions, which is somewhat novel.

You set forth at least one reason: It was that they felt that they were sufficiently competitive to win an adequate amount of research funding to support their university's current or future research effort. Were there other reasons that they had other than the fact that they just felt very capably of being able to get their fair share?

Ms. FRAZIER. No; that was the primary reason. They felt that by use of innovative arrangements by focusing on and continuing to build some of the alliances that they have with industry that some of these successful major research universities are evolving, that they would be able to maintain a high quality research program even in the face of decreased funding.

I think it would be fair to say none of them relished the thought or felt that it was a desirable way to go. But they would be able to maintain the reputation of the university and continue to perform important research.

Mr. FAWELL. As I look at the total R&D budget for the Federal Government and see that on the last two fiscal years that our deficit has come to $242 billion, not counting an $11.7 billion cut by Gramm-Rudman—which may be now gasping for its last breath—and not counting the fact that we also borrowed from Social Security, I think you could add another $30 billion to that $442.

In 2 years we are close to one-half of a trillion dollars in deficit, and I think Congress is not doing anything about it. We are just simply saying, "give the bill to my grandchildren," and walking out of the restaurant.

So I think probably it is going to get worse before it is going to get better. I wish I had some solutions.

Mr. FUQUA. Mr. Lujan?

Mr. LUJAN. Thank you, Mr. Chairman.

Our previous witness said that Wayne State University used 11 percent of it funds, total university funds, for research. Do you have that figure in your study?

Ms. FRAZIER. No; Wayne State was not one of the——

Mr. LUJAN. No, I mean for the 28 that you did study. What percentage of all of the funds of the university are used for research? I believe he said 11 percent of Wayne State was used for research.

Dr. NADEL. I don't think we can break it out specifically that way, because we had it in terms of educational and general reve-

nue, which included instruction. We could probably back out the data for you, though.

Mr. LUJAN. I would imagine what he did is those funds that go in that earmarked for research like the Federal grants, and those kinds of things—that might be interesting to see. I don't know if his is typical of a small school, and yours, of course, were larger.

One of the concerns at the moment is the whole question of indirect funds. Again, our previous witness was saying that one of the universities in Michigan put, I guess, 25 percent of their indirect cost into sinking funds for new buildings; and they didn't, they put it all back into research.

Did you specifically look into that? How many of them did have some kind of a sinking fund or did they used them all back in, plow it into the programs?

Dr. NADEL. No, actually we looked at it the other way. We don't know how many had a sinking fund.

We do know that, I think, three of the universities in our sample did it the way that Wayne State does, that is to return a proportion of the indirect funds to the researchers, in proportion to research volume.

Second, we were asked by the committee to determine, actually, whether the indirect costs for physical plant use went back to physical plant, because generally, the money just goes back to a single pot. You can't really trace it that way.

But we did determine that for the universities in our group, they spent, roughly, 10 times as much each year on physical plant then they received as indirect costs.

Mr. LUJAN. Most of those, I imagine, came from State funding, rather——

Dr. NADEL. Well, it came——

Mr. LUJAN. Well, the 90 percent would have come from State funding. Well, they have, maybe, other grants and private industry, but those are very small, I would imagine; most of it would be State funding?

Dr. NADEL. For the State universities, they obviously would get a large chunk through State funding. For the private universities that——

Mr. LUJAN. Endowments, or gifts, or whatever?

Dr. NADEL. Endowment——

Mr. LUJAN. Thank you, Mr. Chairman.

Mr. FUQUA. Thank you very much for the report and also for being here and discussing it with us today; it will be very helpful to our conclusions.

Dr. NADEL. Thank you.

Mr. FRAZIER. Thank you.

Mr. FUQUA. The next witness will be Mr. Robert Forrester, a partner of Coopers & Lybrand, Boston, MA certified public accounts.

Mr. Forrester, we are very pleased to have you here today. We will make your prepared statement part of the record, if you wish to summarize or in any fashion that you should.

[A biographical sketch of Mr. Forester follows:]

ROBERT T. FORRESTER

Robert T. Forrester, CPA, is a partner in the Boston office of Coopers & Lybrand. His firm examines the financial statements of seven of the ten private universities and one of the public institutions surveyed by the General Accounting Office. In addition to his primary audit responsibilities, which include three private and two public universities, Mr. Forrester serves a number of other universities and research institutions in a consulting role. He is closely involved with standards setting, as well, serving on three task forces of the American Institute of Certified Public Accountants. He chairs the group which reviews standards for audits of Federal programs at educational institutions and serves as a member of task forces which are developing general standards for compliance audits and standards for financial statements of not-for-profit organizations. Mr. Forrester provided advice to GAO during the study.

STATEMENT OF ROBERT T. FORRESTER, PARTNER, COOPERS & LYBRAND, BOSTON, MA

Mr. FORRESTER. Thank you, Mr. Chairman, members of the committee. I am honored to discuss the research of the Government Accounting Office on research university revenues and expenditures. It is a pleasure to meet the users of audited financial statements in a setting which is constructive and without a whole lot of threat to the auditor. Today I intend to comment first on the finances that are described in the GAO study, and to offer a few observations on what seems to work in research funding. As you requested, Mr. Chairman, I shall also discuss the effect of tax reform on universities' financial health, and I shall close with a few reflections on a recent visit I made to a laboratory in one of the institutions that GAO sampled. Needless to say, these observations are based on own experience, and my views don't constitute an opinion of my firm.

From what I have read, Vannevar Bush is largely responsible for the concepts which underlie university research. I understand that your are familiar with the work with Mr. Bush, and I have a personal interest in him. He came to the Government from MIT, which was my first university audit. He also was the cofounder of a large defense contractor in our area, where I cut my teeth as commercial auditor. And finally, he lived with his family, as I do, in Belmont, MA.

In his autobiography, Bush describes a decision that he made that proved to be important, not only for wartime research, but also for the postwar years. This decision set a pattern that shaped the research university that you see described in the report.

Bush did not propose to make a contract with an individual investigator, leaving him with the burden with all the extra costs that might involve, and leaving the university holding the bag with all the extra costs of research and leaving the researcher with the administrative burden. Instead, he proposed to contract with the university itself. He placed on it the responsibility for all administrative matters, and evoked its authority to insure performance of the research.

In return, Bush proposed to pay for the overhead costs of the university, and on an overall basis, not a marginal one. Thus, the Government would reimburse MIT for a portion of its president's salary even though he was in office before research started to be funded by the Government at MIT. This funding decision not only clarified and stabilized the relationships between the universities

and the Government; it also focused responsibility for research and it enhanced the stature of the scientific endeavor.

As you read the GAO report, I invite you to reflect on the stature and responsibility today. These are large institutions.

The operating budgets that are described by the GAO do not include most gifts to endowment, or most construction, and still they average $400 million for each of the institutions sampled. About two-thirds of that is payroll, so that you could figure that these institutions employ between 5,000 and 10,000 people, generally at a single location. Stanford, and Cal, and the rest, would rank high in the Fortune 500 in terms of employment. But their economic effect extends far beyond the campus in New England, from Cambridge and Boston, to Route 128, and to the thriving economies that we have in southern New Hampshire and southern Maine, and up to Burlington, VT. I am sure you also found its influence in Riverside, and northern Florida, in Albuquerque, and in Chicago as well.

How is the financial health of the university, the engine of economic growth? Well, it is now 45 years since Bush's decision, and this is a mature industry. In general, the universities chosen, and the description of their revenues and expenditures in the report are consistent with my experience. The growth in research support from both the Government and private industry has been slow.

Mr. Lujan, in response to your question to the GAO, I think the figure is about 23 percent on the average, of the research—of the total expenditures of the universities. You could say a proportionate amount of revenue supports research at these universities, which is about twice that, which the gentleman from Wayne State described, and that is consistent with my experience between these universities versus the tier that he described.

The schools are looking for new revenue sources. Their costs are rising higher than inflation. They are greatly affected by Federal regulation. Over the past few years they have taken on considerable debt and increasing their operating leverage. Their research buildings, in particular, are at a critical state where they require extensive renovations. Each factor is described in the GAO report, and I concur with each of them.

I would invite your attention, though, to other factors. Some were beyond the scope of the study and some were not fully developed. First, the growth in indirect costs reimbursed as part of the deal made by Vannevar Bush. Well, it is my view that it is hardly as dramatic or as slanted toward administration as some sponsors have previously reported.

Second, the basic distinction between public and private universities is not the only way or even the best way to sort this data. You may wish to try other cuts.

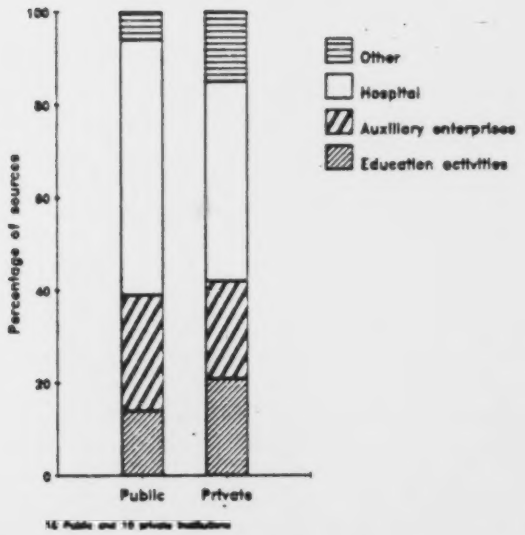
In fact, it is difficult to say anything about the research industry as a whole, not just because these institutions are diverse, but because research activity is controlled by a multitude of individuals without a whole lot of centralized direction at the university.

I would compare the flow of research funds within a university and within the funding system that exists in the Government to a very complicated plumbing system. The proliferation of programs and grants suggest that it would be very hard to identify the winners and losers from any regulatory decision.

Second, the GAO report does not elaborate on the fastest growing component of revenue, auxiliary and other sources. With their large hospitals, academic medical centers will be deeply affected and have been deeply affected by Federal regulations in Medicare and Medicaid. The top section of this auxiliary that is on the chart that is on the previous page of my testimony, and is figure 2.2 in the report, includes proceeds from licensing and other agreements, but I think its fastest growing component may be the revenue that medical centers get from their faculty practice plans.

Figure 2.2

Auxiliary and Other Sources of Revenue, Public and Private Universities (1984)



Anything that changes physicians' incomes will greatly effect the level of funding which is set aside in this way at many medical centers to supplement departmental research.

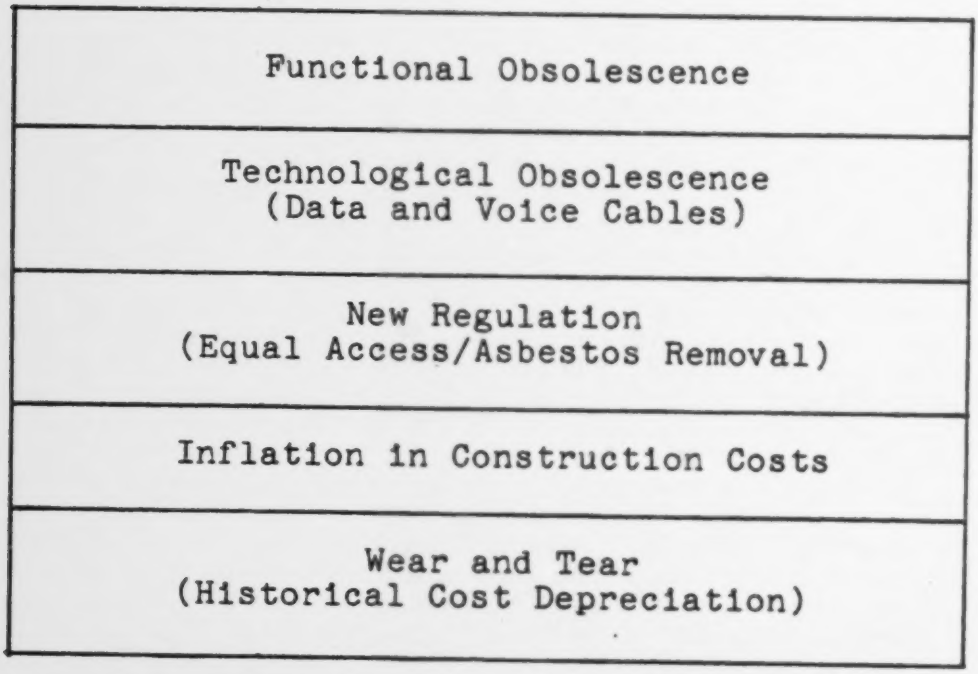
Third, as parent of 11- and 8-year-old daughters I am acutely aware of the absolute increase in tuition since I went to school. At these institutions, however, I don't find much evidence that tuition is subsidizing research.

Fourth, the rapid growth in debt at private institutions over the last 10 years is clear from the report, but somehow debt at public universities at sampled institutions in this report decreased. That is not consistent with my experience and I suggest that you may wish to analyze the data some more to find out why that is true.

Finally, the matter of physical plant. The committee has heard a number of times about the deterioration of the research infrastructure. Some observers have blamed this, in part, upon the accountants, who don't record depreciation at colleges and universities. These observers confuse accounting with funding. Even funded depreciation at historical cost would provide only a fraction of replacement cost shown in the chart below, which starts with wear

and tear, historical cost depreciation and goes on to inflation and construction costs, other components, new regulations—like equal access—and asbestos removal, technological obsolescence, which I find at many of our universities where they are replacing the data and voice cables at great expense.

Replacement Cost of Research Facilities



Finally, functional obsolescence where a wall at any particular university isn't likely to last more than 5 or 6 years because the program changes, and the space needs are very different.

The committee asked the GAO to discuss the universities capacity to accommodate a continued or changing level of Federal research funding in the level. Mr. Chairman, Members of Congress, my experience is that universities are seeing these changes already. Last week I visited the campus of one of the institutions in the report. I found that their grant renewals were being cut from 6 to 14 percent from what they expected. But on the other hand, they have 110 more awards than they had last year. The average award is slightly higher than last year but it supports more people. So for the present, they are cutting supply and travel money and attempting to charge the salary of the principal investigator to departmental or other institutional funds. Administrations at this institution are concerned that scientists, under the new NIH rules which allow easier to pre-award costs, may now borrow money from subsequent years to fund their deficits today. My visit took place before HHS proposed their new changes—not to indirect cost recovery, that is OMB—but to the way they reimbursement in NIH

grants. All this suggests that many investigators will carry on their program at some level, but there may be layoffs in the future.

I have now had the opportunity to describe the innovation of Vannevar Bush and to comment on the financial university that he helped to create. Let me now offer a few observations on what policies seem to work and what policies, in my view, could stand some refinement.

First, a practice I have always considered unwritten part of Bush's deal. It works but it has been thrown out by negotiators from Health and Human Services. That is the tacit agreement that both public and private institutions would absorb the salary of their most senior investigators, while sponsors paid the related indirect costs. Government negotiators are now insisting that, if a university chooses to absorb that salary of a senior faculty member, they have to absorb the indirect cost, too.

Now, perhaps, I am wrong, but a policy like this one, which discourages the sharing of costs, can't be a good one.

Second, the Florida demonstration project of the National Science Foundation, ONR, and others. We haven't yet had enough time to see how well it works, but it has promise for eliminating what one Government administrator has called bureaucratic accretion. I discussed the Florida project last week with the chief executive officer of the State university in our area. He urged that external peer review be a strong part of any program which looks like a block grant.

Another thing that doesn't work as well as it probably should is the cost principle which reimburses interest on facilities and major equipment. As this is written this provision encourages operating leverage. I would suggest that the task force investigate reimbursement of a cost capital as in Cost Accounting Standard 414, on net depreciated plant, or as an incentive on gross plant, if the university has, as have many hospitals, funded their depreciation.

Next, statistics show that pump priming works even if the plumbing is somewhat contorted. I spoke recently with a principle investigator at a State university who had just received an experimental stimulative award from NSF, that is called, EPSCOR. He mentioned another State which had received the grant a while back, and they moved from 49th to 24th in terms Federal research funding among the States by the end of the grant. Another State reported $5 back for every dollar that NSF had given them; $5 from other sponsors. This program offers three things: a local benefit to the State; a competitive review against other States; and external peer review of the quality of research. It is far better, in my view, for universities to compete for these awards than to bypass the appropriations process.

Finally, the statistics themselves. To quote a spokeswoman from the NSF and the New York Times article that I have attached here, where she said, There is a lot of room of ambiguity in the numbers. What the executive branch or individual schools consider basic research, may differ. An independent study of the data, somewhat like Defense's "DFAIR," maybe appropriate.

While I am on this point, I hope you will allow me a small digression. Five years from now the GAO may not be able to provide you with a report such as this. The Governmental Accounting

Standards Board is wresting responsibility for public university accounting principles, which would probably include no depreciation, from the Financial Accounting Standards Board. If this jurisdictional problem is not resolved, users like yourselves will not be able to compare the financial statements of public and private universities, and public and private hospitals.

Mr. Chairman, in your letter you requested that I discuss the potential affects of the Tax Act on research universities. If most of these institutions had an opportunity to vote yes or no on this bill, I doubt whether many would vote in favor of it. Five changes are particularly significant. The first is the proposal to tax stipends of graduate students; their living expenses. At one large university, this could affect 2,000 to 3,000 students who are now working on Federal research, though they work quite cheaply and they may not be married, and therefore, they may not have to file a tax return. I don't know what the figures really are on that. Schools might get reimbursement for the tax, but if you load that with overhead, these stipends make graduate students more expensive than those who already have their degree, postdocs. The result could be to dry up the supply of graduate assistants, and leave us with fewer investigators and fewer teachers 10 years from now.

The next effect on the private institutions is likely to be the inclusion of gains on donated appreciated property in the alternative minimum tax calculation. At one of our clients we annually examine 100 or so gifts over $100,000, and then a sample of the rest. And then I looked at this, this month, well over half of those gifts this year came from appreciated securities or property. For management at another institution, we prepared the attached summary of the effect of this change on the typical donor. It shows that where the security is worth $10,000, and the basis of that security was $2,000, the cost of giving that gift could rise by $3,300 or $3,500.

A third provision would reduce and eventually eliminate deductions for interest on student loans. For some students who take out loans themselves, observers have suggested that this will increase the cost of education by 10 to 15 percent. We have also seen a proliferation of parent loan programs. The net effect of this rule on research universities has to be negative; fewer funds will be available for student support, and parents will pay more through taxable mortgage borrowings and associated administrative charges, and points that they would have paid for tax-exempt student loans.

Another significant change in the proposed tax act is the antidiscrimination rules on deferred annuity plans. I understand that there are other university representatives who will testify before the task force, and I suggest you ask them to describe how these plans work, particularly for senior faculty members. Let me say, however, that I have seen few universities, though there are some, which offer the same relative benefits to a senior research scientist and to other staff. If anti-discrimination is viewed narrowly, these universities will probably not cut the benefits of the senior researchers who are in great demand. Rather, they will increase the benefits of the other staff. The result will be greater cost and less research.

A final provision is the $150 million cap on tax exempt borrowing for facilities. Total debt at a number of the private institutions

in the sample now exceeds the cap. This suggests that the Government will soon be reimbursing interest at these institutions through the overhead rate at taxable rates which exceed Treasury obligations. I submit that that seems an inefficient way to renew the research infrastructure.

The GAO report does not emphasize the fact, but direct Federal support of physical plant decreased by two-thirds from 1975 to 1984. By now, the medical research laboratories originally funded by the Government are 25 or 30 years old. The universities now bear a large cost of maintaining and replacing this infrastructure.

In addressing this cost, I would like you to think, or invite you to consider, not only buildings and large instruments, like electron microscopes, but also normal equipment in a small laboratory like the one I visited last week. A toxicologist in this laboratory wanted to know whether excessive consumption of vegetable fats was responsible for pancreatic cancer. He fed the stuff to a stable of white mice, and then he sliced up their pancreases to see how large and how numerous were the tumors that developed. The trick is to measure the total area of each slice, and then to count and to measure the area of each of lesions which have developed within it.

If we had visited this lab 3 years go, we might have found the following procedure, to measure the total stained area on the slice, the researcher had mounted a slide projector on the wall and he was projecting down on to table where he had put a piece of paper. The slide was then projected and traced onto the piece of paper, and then very carefully he would cut out the area around the slide. He would then throw that on a weight and measure the weight of that particular piece of paper; that would tell him what the area was. To size up each of the lesions, there was another procedure. Behind each slide was a grid and the scientist or his assistant looked through the microscope. They would count the number of blocks that were black that showed lesions or potentially cancerous cells, and the number that were healthy. This went on for each and every slice of each and every pancreases, for every rat in his study.

It is not surprising that this researcher experienced a gap in funding. And that is how I happened to be auditing him. The process simply took too long. Now, the next grant funded some equipment. When I visited him last week, the scientist was looking at a TV screen which was connected to his microscope, and he had an electronic mouse there on the table, and he was measuring the outside of each of the lesions, so that data went into a personal computer which was measuring the number and area of these lesions automatically. That was just for the lesions. For the total area of the slice, he had another machine that he stuck the slice into and the computer automatically recognized light and dark, so that the comparison between the total area and the total lesioned area could be done automatically. The total cost of this equipment was less than $12,000.

I can't look at the charts on pages 40 and 44 of the larger report that the GAO prepared in February, without thinking of this investigator. There are many cases where new equipment is absolutely necessary to do research; in this case it wasn't. But consider the benefits the sponsors will receive when this fellow has a chance to

think about cancer during the day rather than cutting and counting spots on a grid.

With this equipment his research technician now serves 4 or 5 projects in the department, instead of the formally one grant. Her efficiency is up 4 to 1. If this laboratory is representative, a reversal of the trends on pages 40 to 44 should pay for itself. I would also suggest, as he did, that universities and sponsors support awards for teams which would automate small laboratories like this one. With cutbacks in graduate assistants and the increasing costs of people like glass washers, I would urge you not to neglect efficiency as a policy goal for research.

Well, there you have it, a portfolio of modest suggestions about science from CPA. It seems perhaps like a lot of small stuff, like tinkering with the plumbing. In preparing the testimony, I started with a vision of Bush as a synthesizer and a promoter. We certainly need someone like that today. But then I looked at the picture that is on the back of his autobiography. It shows him working at lathe in his basement. This fellow, too, was a tinkerer, with funding mechanics, with interest groups, with the executive branch. I have yet to meet a university administrator or scientist who is satisfied today with the situation which has evolved from his decisions. They feel vulnerable because the challenge in 1986 is greater than the resources that are available to meet it.

What is so special about 1986? Well, the most perspective comment came from my State university president, who said that tinkering is needed now. After the war and Sputnik, he said, the third great period of science funding will be upon us in 8 or 9 years. There will be dramatic run up in the demand for teaching talent when my daughters, and thousands like them, are taking science in college. As an auditor of other Federal assistance programs, I have encountered some which failed when someone did nothing but open the 48-inch valve on a complicated plumbing system. Scientific research is really too subtle for that. Therefore, I applaud and support your effort to make changes now, and not then.

This concludes my prepared statement. I would be happy to answer any questions.

[The prepared statement of Mr. Forrester follows:]

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STATEMENT OF
ROBERT T. FORRESTER, PARTNER, COOPERS & LYBRAND
BEFORE THE SCIENCE POLICY TASK FORCE
OF THE U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
ON
UNIVERSITY FINANCES --
RESEARCH REVENUES AND EXPENDITURES

Mr. Chairman and Members of the Committee:

I am honored to discuss the report of the General Accounting Office on the financial health of research universities. It's a pleasure to meet the users of audited financial statements in a setting which is constructive. I intend to comment first on the university finances described in the GAO report and to offer a few observations on what seems to "work" in research funding. As you requested, I shall also discuss the effect of tax reform on universities' financial health and I shall close with a few reflections on a recent visit I made to a laboratory at one of the institutions sampled by GAO. Needless to say, these observations are based on my personal experience and such views do not constitute an opinion of my Firm.

From what I've read, Vannevar Bush is largely responsible for the concepts which underlie the funding of university research. In his autobiography, he describes a decision that he made which proved to be important, not only for the war years, but for the post-war period as well. This decision set a pattern that shaped the research university GAO describes.

Bush did not propose to make a contract with an individual investigator, leaving his university holding the bag on all the extra costs that might involve, and leaving him with the burden of the contracting affairs. Instead, Bush proposed to contract with the university itself. He placed on it the responsibility for all administrative matters. He evoked its authority to insure performance.

In return, Bush proposed to pay for the overhead costs of the university, on an overall basis, not a marginal one. Thus, the government would reimburse MIT for a portion of its President's salary even though he was in office before research contracts were signed.[1]

[1] The Executive Branch accused Bush of plotting to fatten up the universities at government expense. Bush says, "I just told the House Appropriations Committee what I was doing and how I was going to do it. They seemed to think it was all right, so that was that." Their compliance had something to do with the war. But consider its effect on the post-war period. The pattern of contracting Bush initiated has had lasting and decidedly beneficial effects. Just after the war, Bush tells us, "It was literally a life saver for the universities. Had it not been in force, one of two things would have happened. Either the universities rather generally would have gone bankrupt, or more probably, the scale of research in this country would have been cutback with such stringencies that we would not have been able to support the great surge in industry that later occurred or have been able to train the men and women that kept it going."

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Bush's funding decision not only clarified and stabilized the relations between government and the universities. It also focused responsibility for research and enhanced the stature of the scientific endeavor.

As you read this GAO report I invite you to reflect on that stature and responsibility today. These are large organizations. Their operating budgets do not include gifts to endowment and construction activity. Even so, in 1984 they averaged $400 million at each school. Roughly two thirds of this was payroll and related costs. Thus these institutions employ between 5,000 and 10,000 people, or more, generally at a single location. In terms of employment, Stanford, Cal and the rest would rank high in the Fortune 500. But their economic effect extends far beyond the campus gate -- in New England we find it not only in Cambridge and Boston but on Route 128, in the thriving economies of southern Maine and New Hampshire, and in Burlington, Vermont.

How is the financial health of the research university, the engine of this economic growth? By now, 45 years after Bush's decision, this is a mature industry. In general, the universities chosen and the description of their revenues and expenditures in the GAO report are consistent with my experience. The growth in research support for

both the government and private industry has been slow. These schools are looking for new revenue sources. Their costs are rising faster than inflation. They are greatly affected by Federal regulation.[2] Over the past few years they have taken on significant debt and increased their operating leverage. Their research buildings, in particular, are at a critical stage which requires expensive renovation.[3] All these factors are described in the GAO report. I concur with each.

I would invite your attention to other factors, too. Some were beyond the scope of the study, others were identified but not fully analyzed. First, the growth in indirect costs reimbursed as part of the deal made by Vannevar Bush. It's hardly as dramatic, or as skewed to administration, as some sponsors have previously reported.

Second, the basic distinction -- between public and private institutions -- is not the only way, or perhaps even the best way, to sort the data. You may wish to try other cuts.[4]

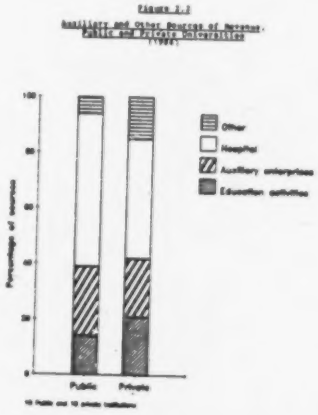
[2] In March, we held a seminar for 15 universities in the Northeast on potential changes in the cost principles. These changes would have cost this group of institutions over $50 million per year.

[3] $28 million for Harvard's Biology Laboratories alone.

[4] For example, farm states versus other regions; institutions with medical schools versus those which have none; or perhaps those who participate in large scientific projects, like supercomputers or have significant defense funding versus those who have other sorts of sponsorship. Of course, there are other institutions, such as the Marine Biological Laboratory, the Woods Hole Oceanographic Institution, the Draper Laboratories, and the Whitehead Institute, in Massachusetts alone, which conduct significant research for the government but are not part of the GAO study.

In fact, it is difficult to say anything about the research industry as a whole, not just because these institutions are diverse, but because research activity is controlled by a multitude of people without centralized direction.[5] The proliferation of programs and grants suggests that it will be very hard to identify the winners and losers from any regulatory decision.[6]

Second, the GAO report does not elaborate the fastest growing component of revenue, auxiliary and other sources. (See Figure 2.2 below.)



[5] Even a leading text on research administration (by Raymond Woodrow of Princeton) suggests that one does not "manage" research but rather creates an environment and a management style which is healthy for research. Still, there may be opportunities for management decisions, such as seeking a "diverse array of support." (See September 8, 1986, New York Times article, attached.)

[6] For example, one institution with which I am familiar would have lost $1 million under the A-21 proposal OMB made in February, but stands to gain over $300,000 instead from the final June revision.

With their large hospitals, academic medical centers will be deeply affected by Federal regulations in Medicare and Medicaid. The top category ("other") includes proceeds from licensing and other agreements, but its fastest growing component may be the revenue medical centers generate from faculty practice plans. Anything that changes physicians' incomes will greatly effect the level of funding which is set aside at many medical centers to supplement departmental research.

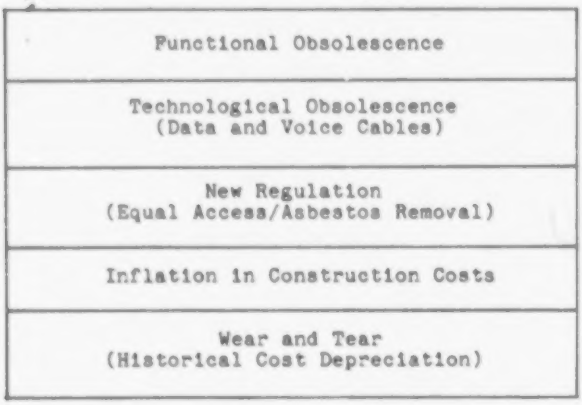
Third, as a parent of 11 and eight year old daughters, I am acutely aware of the absolute increase in tuition since I went to school. At these institutions, however, I do not find much evidence that tuition subsidizes research.

Fourth, the rapid growth in debt at private institutions is clear from the report; but somehow debt at public universities in the sample decreased during the 1975-84 period. This is not consistent with my experience and you may wish to analyze the data some more.[7]

[7] There may be institutions in the sample where peaks in state budget surpluses have funded capital at the universities directly. Other states, like Massachusetts, may incur obligations which remain on their books, or that of an independent authority, even though the plant is shown on the university's. I would also suggest that the Committee extend the study to debt incurred by all institutions from July 1, 1984 through December 31, 1985 -- a period of significant borrowing.

Finally, the matter of physical plant. The Committee has heard a number of times about the deterioration of the research infrastructure. Some observers have blamed this, in part, upon the accountants, who do not record depreciation.[8] These observers confuse accounting and funding. Even funded depreciation at historical cost would provide only a fraction of replacement cost shown in the chart below.

Replacement Cost of Research Facilities



[8] The GAO report points out that there is no depreciation in colleges and universities; that is, that university budgets are balanced without a systematic charge for the cost of assets that are being used in the period. This accounting practice may seem strange to those more familiar with commercial methods, but it's not greatly different from governmental accounting. Congress may find it difficult to justify to its constituents an appropriation to fund depreciation of a 20th or a 10th of Washington's Metro, the year after the Department of Transportation had spent millions to build the system in the first place. This is not to say that university financial statements should not bear a charge for capital maintenance; and the Financial Accounting Series, Statement of Financial Accounting Concepts No. 6 (December 1985) said that they eventually should.

The Committee requested that the GAO discuss universities' capacity to accommodate a continued or changing level of Federal research funding in the future. Mr. Chairman, Members of the Committee, my experience is that universities are seeing such changes already. Last week I visited the campus of one of the institutions in the report. Their grant renewals are being cut by six to 14 percent from what they expected, but they have 100 more awards than last year. The average award is slightly higher than last year, but the new awards support more people. For the present, they are cutting supply and travel money and attempting to charge the salary of the principal investigator to departmental or private funds. NIH has recently revised its rules on pre-award costs. Administrators at this institution are concerned that scientists may now borrow money from subsequent years to fund current deficits. All this suggests that many investigators will carry their programs at some level for a short time, but that there may be lay-offs in the future.

I have now had the opportunity to describe the innovation of Vannevar Bush and to comment on the financial health of the institutions his decision helped to create. Let me now offer a few observations on what policies work, and which, in my view, could stand refinement.

First, a practice I've always considered an unwritten part of Bush's "deal." It works but has been thrown out by negotiators from the Department of Health and Human Services. That's the tacit agreement that both public and private institutions would absorb the salary of senior investigators, while sponsors paid for the related indirect costs. Government negotiators are now insisting that, if a university chooses to absorb the salary of a faculty member, they have to absorb indirect costs, too. Perhaps I am wrong, but a policy like this, that discourages sharing of costs, can't be a good one.[9]

Second, the Florida demonstration project of NSF, ONR, and others. We haven't yet had enough time to see if it works, but it has promise for eliminating what one government administrator has called "bureaucratic accretion." I discussed the Florida project last week with the chief executive officer of a public institution in our area. He urged that external peer review be a strong part of any program that looks like a "block grant".

[9] The effect of the negotiators' position is to force the universities to charge to each of their thousands of research projects the salaries of principal investigators, who would be doing research anyway, rather than the equipment, supplies, and assistants who would broaden the research, and were the reason the grant was sought in the first place. The price of research stays the same, but the amount of research decreases.

Another thing that doesn't work as well as it should is the cost principle which reimburses interest on facilities and major equipment. As it is written, this provision encourages operating leverage. I would suggest that the Task Force investigate reimbursement of a cost of capital (as in Cost Accounting Standard (CAS) 414) on net (depreciated) plant, or, as an incentive, on gross plant (if the university has, as have many hospitals, funded the depreciation).[10]

Next, statistics show that "pump priming" works even if the plumbing is contorted. I spoke recently with a principle investigator at a state university which had just received an experimental stimulative program (EPSCOR) grant from NSF.[11] He mentioned another state which had received the grant a while back, and had moved from 49th in Federal funding to 24th by the end of the grant. Another state had reported $5 back in other funding for every dollar spent by NSF. This program offers three things: a local benefit, a competitive review against other states, and an external review of the quality of research. It is far better, in my view, for universities to compete for these awards than to bypass the appropriations process.

[10] The present cost principle also gives universities an incentive to charge research facilities to debt, and to extend the maturity on that debt, while they charge other academic plant to other funds. One university is now setting up a "blended pool" of construction funds from debt and equity.

[11] I could not identify the EPSCOR program in the GAO's February report.

Finally, the statistics themselves. To quote a spokeswoman from the NSF, "There is a lot of room for ambiguity in the numbers." What the Executive Branch, or individual schools, consider "basic research" may differ. An independent study of the data, somewhat like Defense's "DFAIR," may be appropriate. While I'm on this point, I hope you will allow a small degression. Five years from now the GAO may not be able to provide you with a report such as this. The Governmental Accounting Standards Board (GASB) is currently wresting responsibility for public university accounting principles (which would probably include no depreciation) from the Financial Accounting Standards Board. If this jurisdictional problem is not resolved, users like yourselves will not be able to compare the financial statements of public and private universities and hospitals.

Mr. Chairman, in your letter you requested that I discuss the potential effects of the proposed Tax Act on research universities. In summary, if most of these institutions had the opportunity to vote "yes" or "no" on this bill, I doubt that many would vote in favor of it. Five changes are particularly significant. The first is the proposal to tax stipends for living expenses of graduate students. At one large university, this could affect two to three thousand students who now work on federal research (though they work quite cheaply so one can't be sure how many would pay tax under the new bill). Schools

students for the tax, but loaded with overhead, these stipends make grad students more expensive than post-docs. The result could be to dry up some of the supply of graduate assistants, and leave us with fewer investigators and teachers ten years from now.[12]

The next effect on the private institutions is likely to be the inclusion of gains on donated appreciated property in the alternative minimum tax calculation. At one of our clients we annually examine the 100 or so gifts over $100,000 (and a sample of the rest). This year, well over half of those large gifts were in appreciated securities or property.[13]

[12] This effect is suggested by Professor Lawrence B. Lindsey of Harvard in the September 4, 1986, Boston Globe (p. 37). "Ten years from now there will be a lot fewer college teachers." This is not to say that all disciplines are now experiencing a shortage. Robert G. Petersdorf, in Daedalus reports, "It is estimated, based on the steady percentage of graduates entering internal medicine and the training capacity of internal medicine, that, by 1990, there will be 110,000 internists; approximately 10% of these will need to be academicians. This suggests a demand for 10,000 to 13,000 individuals; however, the number of academic internists now projected to be fully trained in 190 is 27,000." Medical Schools and Research: Is the Tail Wagging the Dog? Daedalus, Spring 1986, page 106.

[13] Many of these large gifts of appreciated securities support professorships. Cutbacks in those gifts would increase the effort of principle investigators charged to Federal programs, and decrease the amount that was left over for items like equipment. Other gifts provide specific fellowships or general departmental support for graduate students. I invite your attention to page 51 of the GAO report. Nine universities -- all public -- cited difficulties in recruiting graduate students in science and engineering. Private institutions apparently succeed in such recruiting, at least in part, because private fellowships are available. I went to graduate school on one myself. So this tax provision may also affect the number of graduate students who perform research.

For management at another institution, we prepared the attached summary of the effect of this change on a typical donor. It shows that the cost of a $10,000 gift could rise by over $3,500.[14]

A third provision would reduce, and eventually eliminate, deductions for interest on student loans. For some students who take out the loans themselves, observers have suggested that this provision could increase the cost of education by 10-15%. Lately we've also seen a proliferation of parent loan programs. The net effect of this rule on research universities has to be negative: fewer funds will be available for student support, and parents will pay more through taxable mortgage borrowings and the associated administrative charges, than they would have paid for tax exempt student loans.[15]

[14] I suppose that colleges will now pursue other sorts of gifts. Last week, one client predicted more bargain sales of primary residences, which are subject to an exclusion; another was reviewing a prospective gift of two tax shelters.

[15] I doubt if the colleges and public authorities which have started these programs will want to get into the second mortgage business after they start dealing with title insurance companies outside their own states. As a result, we may see a lot of local mortgage refinancing and some idle cash at the student loan authorities and the colleges themselves. In many cases, the cash was borrowed at a rate higher than it could earn now. Some programs could redeem bonds, but others (perhaps supported indirectly by some of the research universities) could wind up in financial difficulty. The colleges and student loan authorities may attempt to establish liens on parents' homes without going through a formal mortgage process.

In my view, a significant change in the proposed Tax Act is the anti-discrimination rules on deferred annuity plans. I understand that university representatives will also testify before this Task Force. I would suggest that you ask them to describe how the plans work, particularly for senior faculty members. Let me say, however, that I have seen few universities (though there are some) which offer the same relative benefits to a research professor and other staff. If anti-discrimination is viewed narrowly, these universities will probably not cut the benefits for senior researchers who are in great demand. Instead they'll increase the benefits of other staff. The result will be greater cost and less research.

A final provision is the $150 million cap on tax exempt borrowing for facilities. Total debt at a number of the private institutions in GAO's sample now exceeds the cap. This suggests that the government will soon be reimbursing interest through overhead at taxable rates which exceed Treasury obligations. This seems an inefficient way to renew the research infrastructure.

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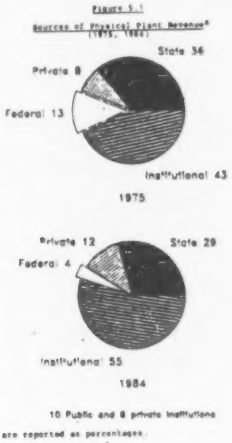
The GAO report does not emphasize the fact, but direct federal support of physical plant decreased by two-thirds from 1975-84.



10 Public and 8 private institutions

*Sources are reported as percentages.

By now, the medical research laboratories originally funded by the government are 25 to 30 years old. There is a large cost of maintaining this capital investment in the research infrastructure. In addressing this cost, I invite you to consider not only buildings like the Bio Labs and large instruments like electron microscopes, but equipment in a small laboratory like the one I visited last week. Does excessive consumption of vegetable fats cause pancreatic cancer? A toxicologist in this lab at one of the sample schools wanted to know. So did a number of his sponsors. He fed the stuff to a stable of white mice, then sliced up their pancreases to see how large and how numerous, were the tumors which developed. The trick is to measure the total area of the slice, then measure the size of each lesion within it.

If we had visited the lab three years ago, we might have found the following procedures: to measure the total area, the scientist had fastened a slide projector to the wall, projected the slice on a piece of paper, and cut precisely around the stained area. Then he would weigh the paper and figure its area by a standard measure. To size up the lesions there was another procedure: behind each slide was a grid. As the scientist or his assistant looked through the microscope, they would count the number of blocks which were filled with black cells (lesions) or white cells (healthy). This went on for each and every pancreas section, for each and every rat in the study.

It's not surprising that this researcher experienced a gap in funding. The process simply took too long. The next grant funded some equipment. When I visited him recently, the scientist was looking at a TV screen connected to the microscope, not through the eyepiece itself, and he was moving a computer mouse around the dark sections, so that the personal computer he had purchased could measure the cancerous area automatically. (See Figure 5 below.) That was just for the lesions. For the total area, the computer had been programmed to recognize dark and light areas automatically, so that these were measured at once as they were put into another machine. If the computer could be taught to recognize a lesion, I suppose the scientist could simply load the slides beside the microscope like so many records and let the computer play each, for a silent audience, as he went home at night. That would be the next step in a lab that worked with perfect slides.

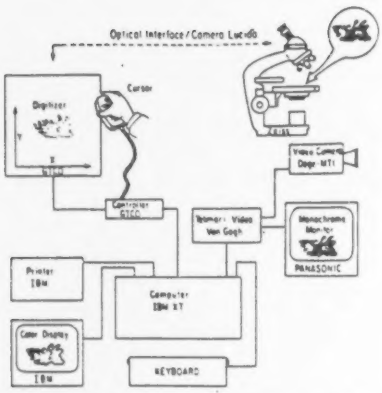
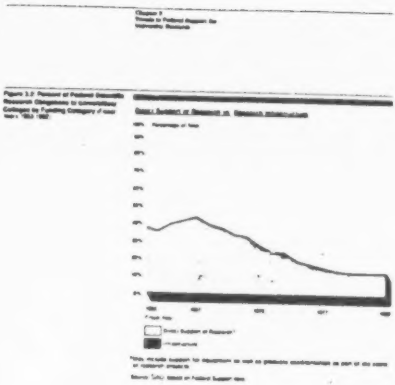
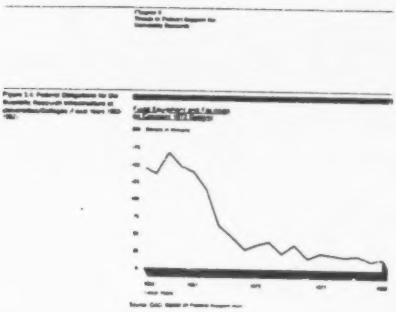


Figure 5. Image analysis system allowing semi-automatic data acquisition of tissue areas, focal counts, and the calculation of quantitative stereologic values.

The total cost of his equipment was less than $12,000. I can't look at the charts on support of infrastructure on pages 40 and 44 of the GAO's February report on University Funding (below), without thinking of this investigator. There are many cases where new equipment is absolutely necessary to do research. Here it wasn't. But consider the benefit government sponsors will receive when the scientist has a chance to think about cancer during the day, rather than cutting paper and counting spots on a grid like a game of battleship.

With this equipment his research technician now serves four or five projects in the department, instead of this scientist's single grant. Her efficiency is up four to one. If this laboratory is representative, a reversal of the trend on pages 40 and 44 should pay for itself. I would also suggest that universities and sponsors support awards for teams which would automate small labs like this one. With the cutbacks in graduate assistants and the increasing cost of glass washers, I would urge you not to neglect efficiency as a policy goal.





There you have it, a portfolio of modest suggestions about science from a CPA. It seems like a lot of small stuff, tinkering with the plumbing. In preparing the testimony, I started with a vision of Bush as a synthesizer and a promoter. (The business clearly needs one today.) But then I looked at the picture on the back of his autobiography. He's working at the lathe in his basement. This fellow, too, was a tinkerer: with funding mechanics, interest groups, and members of the Executive Branch. I have yet to meet a university administrator or scientist who is satisfied with the deal which has evolved from Bush's innovation today. They feel vulnerable because the challenge in 1986 is greater than the resources available to meet it.

What's special about 1986? The most perceptive comment came from my state university CEO who said that tinkering is needed now. After the war and Sputnik, he said, the third great period of science, will be upon us in eight or nine years. There will be a dramatic run up in demand for teaching talent when my daughters, and thousands like them, are taking science in college. As an auditor of other Federal assistance programs, I have encountered some which failed when someone did nothing but open the 48 inch valve on a complicated plumbing system. Scientific research is really too subtle for that. Therefore, I applaud and support your effort to make changes now, not then.

This concludes my prepared statement. I would be glad to answer any questions.

IMPACT OF 1986 TAX REFORM BILL ON CONTRIBUTIONS OF APPRECIATED PROPERTY

ASSUMPTIONS

1. Married couple filing jointly with three children.

2. One parent does not work.

3. Income:

   Wages - $100,000
   Long-term capital gain - $15,000
   Dividends - $10,000
   Interest - $5,000
   Real estate partnerships annual loss - $22,500
   Investment in real estate partnerships - $10,000
   IDB interest (non-essential) - $20,000

4. Deductions:

   IRA - $2,250
   Home mortgage interest - $12,000
   Taxes - real estate and income - $15,000
   Miscellaneous deductions - $7,500

5. Calculations made with an additional contribution of appreciated property assume a fair market value of $10,000 and a cost basis of $2,000.

1987 PROJECTIONS	HOUSE BILL				SENATE BILL				CONFERENCE COMMITTEE BILL			
	Reg. tax w/o/gift	AMT w/o gift	Reg. tax w/ gift	AMT w/ gift	Reg Tax w/o gift	AMT w/o gift	Reg. Tax w/ gift	AMT w/ gift	Reg. Tax w/o gift	AMT w/o gift	Reg. Tax w/ gift	AMT w/ gift
INCOME												
Wages	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Long-term capital gain	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Long-term capital gain deduction	(6,300)	(4,500)	(6,300)	(4,500)								
Dividends	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Interest	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Real estate partnerships	(22,500)	(10,000)	(22,500)	(10,000)	(14,625)		(14,625)		(14,625)		(14,625)	
IDB interest (non-essential)		20,000		20,000						20,000		20,000
IRA	(2,250)	(2,250)	(2,250)	(2,250)								
Adjusted Gross Income	98,950	133,250	98,950	133,250	115,375	130,000	115,375	130,000	115,375	150,000	115,375	150,000
DEDUCTIONS												
Home mortgage interest	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)	(12,000)
Taxes (real estate & income)	(15,000)		(15,000)		(15,000)		(15,000)		(15,000)		(15,000)	
Charitable contributions - cash	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)
Charitable contributions - appreciated property			(10,000)	(2,000)			(10,000)	(10,000)			(10,000)	(2,000)
Miscellaneous deductions	(6,511)		(6,511)						(5,193)		(5,193)	
Standard deduction	4,800		4,800		3,670		3,670		5,000		5,000	
Personal exemptions	(10,000)		(10,000)		(9,500)		(9,500)		(9,500)		(9,500)	
Itemized deduction reduction	2,500		2,500									
Minimum tax exemption		(40,000)		(40,000)		(40,000)		(40,000)		(40,000)		(40,000)
Taxable Income	52,740	71,250	42,740	69,250	72,545	68,000	62,545	58,000	68,683	88,000	58,683	86,000
Tax	11,188	17,813	7,715	17,313	18,468	13,600	15,031	11,600	17,129	18,480	13,629	18,060
15% bracket phase-out surcharge					1,009		1,009					
Total Tax	11,188	17,813	7,715	17,313	19,477	13,600	16,041	11,600	17,129	18,480	13,629	18,060
Tax with gift		(17,313)			(16,041)					(18,060)		
Tax savings from gift of appreciated property		500			3,436					420		

1986 PROJECTIONS	PRESENT LAW PROVISIONS			
	Reg. tax w/o gift	AMT w/o gift	Reg. tax w/ gift	AMT w/ gift
INCOME				
Wages	100,000	100,000	100,000	100,000
Long-term capital gain	15,000	15,000	15,000	15,000
Long-term capital gain deduction	(9,000)		(9,000)	
Dividends	10,000	10,200	10,000	10,200
Interest	5,000	5,000	5,000	5,000
Real estate partnerships	(22,500)	(22,500)	(22,500)	(22,500)
IDB interest (non-essential)				
IRA	(2,250)	(2,250)	(2,250)	(2,250)
Adjusted Gross Income	96,250	105,450	96,250	105,450
DEDUCTIONS				
Home mortgage interest	(12,000)	(12,000)	(12,000)	(12,000)
Taxes (real estate & income)	(15,000)		(15,000)	
Charitable contributions - cash	(10,000)	(10,000)	(10,000)	(10,000)
Charitable contributions - appreciated property			(10,000)	(10,000)
Miscellaneous deductions	(7,500)		(7,500)	
Zero bracket amount	3,670		3,670	
Personal exemptions	(5,400)		(5,400)	
Minimum tax exemption		(40,000)		(40,000)
Taxable Income	50,020	43,450	40,020	33,450
Total Tax	10,772	8,690	7,441	6,690
Tax with gift	(7,441)			
Tax savings from gift of appreciated property	3,331			

1988 PROJECTIONS	CONFERENCE COMMITTEE AGREEMENT			
	Reg. tax w/o gift	AMT w/o gift	Reg. tax w/ gift	AMT w/ gift
INCOME				
Wages	100,000	100,000	100,000	100,000
Long-term capital gain	15,000	15,000	15,000	15,000
Long-term capital gain deduction				
Dividends	10,000	10,000	10,000	10,000
Interest	5,000	5,000	5,000	5,000
Real estate partnerships	(9,000)		(9,000)	
IDB interest (non-essential)		20,000		20,000
IRA				
Adjusted Gross Income	121,000	150,000	121,000	150,000
DEDUCTIONS				
Home mortgage interest	(12,000)	(12,000)	(12,000)	(12,000)
Taxes (real estate & income)	(15,000)		(15,000)	
Charitable contributions - cash	(10,000)	(10,000)	(10,000)	(10,000)
Charitable contributions - appreciated property			(10,000)	(2,000)
Miscellaneous deductions	(5,080)		(5,080)	
Standard deduction	5,000		5,000	
Personal exemptions	(9,750)		(9,750)	
Minimum tax exemption		(40,000)		(40,000)
Taxable Income	74,170	88,000	64,170	86,000
Tax	16,900	18,480	14,100	18,060
15% Bracket phase-out surcharge	114		0	
Total Tax	17,013	18,480	14,100	18,060
Tax with gift		(18,060)		
Tax savings from gift of appreciated property		420		

1989 PROJECTIONS	CONFERENCE COMMITTEE BILL			
	Reg. Tax w/o gift	AMT w/ gift	Reg. Tax w/ gift	AMT w/ gift
INCOME				
Wages	100,000	100,000	100,000	100,000
Long-term capital gain	15,000	15,000	15,000	15,000
Long-term capital gain deduction				
Dividends	10,000	10,000	10,000	10,000
Interest	5,000	5,000	5,000	5,000
Real estate partnerships	(4,500)		(4,500)	
IDB interest (non-essential)		20,000		20,000
IRA				
Adjusted Gross Income	125,500	150,000	125,500	150,000
DEDUCTIONS				
Home mortgage interest	(12,000)	(12,000)	(12,000)	(12,000)
Taxes (real estate & income)	(15,000)		(15,000)	
Charitable contributions - cash	(10,000)	(10,000)	(10,000)	(10,000)
Charitable contributions - appreciated property			(10,000)	(2,000)
Miscellaneous deductions	(4,990)		(4,990)	
Standard deduction	5,000		5,000	
Personal exemptions	(10,000)		(10,000)	
Minimum tax exemption		(40,000)		(40,000)
Taxable Income	78,510	88,000	68,510	86,000
Tax	18,115	18,480	15,315	18,060
15% bracket phase-out surcharge	331		0	
Total Tax	18,445	18,480	15,315	18,060
Tax with gift		(18,060)		
Tax savings from gift of appreciated property		420		

THE NEW YORK TIMES, MONDAY, SEPTEMBER 6, 1965

U.S. Research Sponsorship Soars at Universities

By DAVID E. SANGER
Special to The New York Times

CAMBRIDGE, Mass., Sept. 7 — Federal sponsorship of basic scientific research at universities has soared in the first six years of the Johnson Administration, in a reversal that appears to have ended the post-Sputnik era of the early 1960's.

The dramatic increase — 65 percent since 1961, to more than $4 billion in private this year — has surprised university officials, many of whom were alarmed just a few years ago that Federal research would be an early casualty of Federal budget cuts.

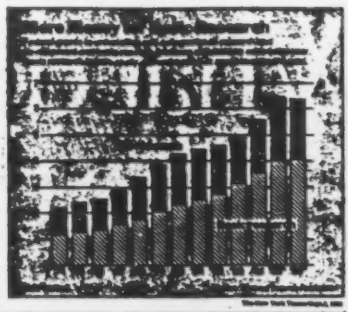
But the many similarities, the surprises by no accurately understood. Both Government decisions and interviews with researchers across the country indicate that the Administration has concentrated much of its basic research funding in unusually large projects, and in universities with strong graduate and advanced engineering programs around the country, or in technological areas considered critical to industrial or military competitiveness.

As a result, scholars say that funds for individual scientists, especially those not working in the heavily favored areas of advanced computer sciences, biotechnology or atmospheric sciences, for example, may be reduced. Many fear "famine and feast," Kenneth A. Smith, the vice president of research at the Massachusetts Institute of Technology, said the other day, "here you are funded expands on when kind of research you do."

Pentagon Not a Big Factor

Although many academicians feared that the influx of money from the Pentagon, Defense industries and other military projects would distort basic university research, growth in basic research has, so far, not come from the Pentagon. In fact, Defense Department support of basic research fell for several years in relation to "applied" undertakings, including work on space-related defense systems, scientific officials say. But starting in the fiscal year 1966, according to National Science Foundation estimates, the upward curves of new basic research funds in the Pentagon.

Meanwhile, private industry, which only a few years ago seemed to be pressing to supplant Government support in a host of critical research areas, has moved for many already than expected in underwriting university research. While a dozen or so major corporations have established close ties with university researchers in research centers, executives officials say, they have largely failed to finance studies of basic natural scientific issues. They have turned to universities primarily for help in developing technological ideas to yield quick commercial results.



Thomas Von Hoffman/Staff, NYT

These shifts in how the nation conducts basic research — widely regarded as essential to spurring scientific breakthroughs — were a recurring theme of economists and industry officials here at M.I.T. yesterday, as they began a two-day conference on Government-university relationships.

The conference, which many leaders of universities, Jerome B. Wiesner, an adviser to several presidents on scientific affairs and an M.I.T. professor, warned that in the past governments funds "were given with less concern and fewer strings, and government that it would be available for long-term research." And he said that M.I.T., with its close links to industry, had learned that "there is an totally human source of support." The concern, he said, by enabling a diverse array of research sponsors, so that no university is not overly dependent on any single source.

'Forces Beyond Their Control'

And at Harvard's closing conference on Saturday, David C. Bok, the university's president, cautioned that Federal administration of research cutbacks "are dangerous because forces beyond their control." Mr. Bok, who was deeply involved in Harvard's effort several years ago to start the university's own biotechnology company, said when then talked the plan, they worried about the dangers of new temptations for academicians.

"In a world where scholars have to specialize so narrowly and rely so much on external sources for recognition and support," said Mr. Bok, "incentives are already divided between the university, the professions, and the agencies that supply them with much needed funds."

Meanwhile, he said, there was some danger that humanity would stray from their academic goals as they sought to market their expertise in "specialized training" that provided them with "a rewarding source of satisfaction, variety, status and income."

'Focus on Basic Research'

Among other issues that arose in Cambridge last week, and in interviews with other researchers:

Many researchers contend that the Johnson Administration's support of basic research is partly illusory, the result of re-classifications of projects that are really committed to quick applications. "The emphasis is very good," said Fred Stuart Rice, dean of the division of physical sciences at the University of Chicago. "In many so-called basic research, but the projects that get funded have opportunities in the short term."

The recent studies, a small but significant percentage of university research related to "thrusts" that Government sponsors, have that the choices of research projects funded does more alternatives to industry or Government sponsors, more than the Government officials from time to time acknowledge. Some of the most promising research, they say, is often that has resulted in studies of chemistry and computer technology.

"Among the hardest hit researchers in the next few years, experts say, will be those specializing in the fields of space science. With gasoline and other costs to rocketry supply at relatively low prices, the Energy Department has shortly cut back on conservation energy research, while the National Aeronautics and Space Administration's basic research budget is expected to be hit hard to help pay the $7 billion needed to replace the Space shuttle Challenger.

Competition Spurring Investment in Research

While they debate the ends and means of the revival in basic research, experts and Government officials appear to agree that the national boom in research and development, a key factor behind basic research, has been spurred largely by the fears of the cold war, competition from abroad.

The Congressional Research Service, which assisted with the study, found that Federal aid to basic research in the universities today consists of "a mixture of motives and objectives." Basic research funds in fields such as physics "are supporting cold war aims," another study said. Much of the investment, it said, was due to research personnel, and to the "prestige" of Federal support that Government at an extremely high cost of 30 percent, according to the study.

At the same time, many say that the Government's view of its role has changed in recent years. "In the past few years, the thing we all prided ourselves on as a nation was that we were the envy of the world," said Professor Rice of Chicago. "That's not the case anymore."

Professor Rice and others say the interests in the Government's new commitments to unusually large scientific projects, such as those projects that promise to produce earlier Government results. For example, the expansion of basic research in the fields of medicine is largely by the National Science Foundation was backed by many scholars who said they simply did not have the money to take the nation over-all basic research — widely regarded as essential to spurring scientific breakthroughs — were a recurring theme of economists and industry officials here at M.I.T. yesterday, as they began a two-day conference on Government-university relationships.

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Companies Rarely Make Major Unrestricted Gifts

"I think universities have learned what we all suspected — that industry is basically looking for a quid pro quo," said Jerome Rothen, a professor of physics and dean of the faculty at Harvard. "So it is still rare to see a company make a major unrestricted gift," he said that a university could use for basic research.

Indeed, some early concerns that industry funds for specific projects could limit the openness or direction of university research appear to have not proved, some university administrators say.

For example, many of the contracts made in recent years between universities and corporations give the sponsoring company exclusive rights to the research results despite the fact that the presidents of several leading research institutes concluded four years ago that such restrictions on the university's publication rights should be avoided.

"The fact of the matter," said one Stanford University dean, "is that even when we refuse to give exclusive rights, we don't get them."

And a recent Harvard study of biochemistry researchers across the country, published in June in the journal Science, concluded that biotechnology researchers receiving industrial funds "do not appear to be significantly different from their colleagues without industrial support."

Citing the accomplishments of university scientists with business, many university officials appear to have abandoned fears of the early 1960's that Federal support, as Harvard's president, unintentionally, in 1958. University administrators were taken by surprise when faculty members objected strongly to the plan, maintaining that Harvard scientists might be tempted to do research that would have a commercial rather than basic value.

"The idea was to establish a steady source of funding for our research, rather than scrambling on the open end system of handouts," Daniel Bell, Harvard's sociologist pointed out in defending the plan. "It was not primarily that the forces related to the cold war, he said, "were bound up in its many conditions. Now, I think it is fair to say that we are on the commercialization of the operation."

"Universities that are better off," he concluded, "can afford to be cautious."

Industrial Researchers Publish More Frequently

The study also concluded that nearly a quarter of the scientists working with industrial funds have received more than three months for research results the property of the sponsor, yet the university it found that contrary to many early fears, researchers receiving industry funds probably published more research papers frequently than colleagues without industrial support.

Citing the accomplishments of university scientists with business, many university officials appear to have abandoned fears of the early 1960's that Federal support, as Harvard's president, unintentionally, in 1958. University administrators were taken by surprise when faculty members objected strongly to the plan, maintaining that Harvard scientists might be tempted to do research that would have a commercial rather than basic value.

"The idea was to establish a steady source of funding for our research, rather than scrambling on the open end system of handouts," Daniel Bell, Harvard's sociologist pointed out in defending the plan. "It was not primarily that the forces related to the cold war, he said, "were bound up in its many conditions. Now, I think it is fair to say that we are on the commercialization of the operation."

"Universities that are better off," he concluded, "can afford to be cautious."

DISCUSSION

Mr. FUQUA. Thank you very much, Mr. Forrester, for a very interesting and comprehensive report from the green shades of a CPA. I think you point out some very realistic problems, particularly associated with the tax bill. I am still trying to find out what is in the bill. I appreciate you being able to shed some light on it. Maybe outside people can get more information than Members of Congress about what is in the bill.

I am concerned about the impact, as you stated. We, as a national goal, are trying to stimulate university research, and private giving, and so forth, and the comments you made about depreciated assets, depreciated property, is very alarming. While we are attempting to do one thing, we are probably creating a very serious hiatus on the other hand. Also, the problem of the living expenses for graduate students seems to bring about a very inequitable situation. We are trying to stimulate graduate students, and here our tax policy is having just the reverse effect.

I don't really have any questions. I think your statement kind of answered a lot of them, and raised some of the ones that I have.

Mr. Fawell, do you have any questions?

Mr. FAWELL. The only point that I noted was your statement that you were acutely aware of the absolute increase in tuition, but you didn't find much evidence that tuition subsidizes research.

Why is that good or is that bad, is the question?

Certainly tuitions have gone up. And there are those who suggest that they went up much too far; and a number of institutions were extremely wealthy as a result of it. I don't know if that is a valid statement. But you seem to believe that there is nothing therefrom that is seeping into the research area?

Mr. FORRESTER. It is hard to track because the system is so complicated. But in the medical schools, in particular, that I am familiar with, the student body is so small in comparison with the size of the research that there is very little of an effect back and forth from one to the other.

In the undergraduate curriculum in these universities there isn't much research. In a graduate curriculum, the tuition is really calculated and charged in a completely different way.

There is no direct—none, that I am familiar with in my experience, of a direct support and subsidy, of tuition to research.

Mr. FAWELL. In regard to the tax reform, I don't know what to think there. It is so vast, so great, so immense, that I think that we in Congress, and this is just one example, the references which you made, are just basically unaware as to what we are doing.

We all hope that we are not screwing the situation up too badly. It may work out. But I read reports every day by experts that seem to be contradicting each other.

But here, insofar as higher education is concerned, I think that you are right that most would not vote for that tax bill. They see a lot of detriment.

I think it will have an effect upon research, there is no question about it.

Mr. FUQUA. Mr. Lujan?

Mr. LUJAN. Since we have got a CPA with this background it might be a good time to examine something that just occurred to me recently.

We all think how great research is, that we ought to do more research. The President's Commission on Industrial Competitiveness said that was our big thing, that our technology, our knowledge, that is what would keep us in the forefront of trade worldwide.

I was at a meeting about 2 weeks ago that caused me some concern. How do we quantify the value of this research?

Let me put it another way, negatively. Should we be spending this much money on research?

Let me tell you what got me to wondering about that; not that I would think that you have to reduce it.

But in quantifying it, the Federal Government, we were looking at technology transfer. The Federal Government has 28,000 patents that have been developed in our laboratories and in universities under grants, and this sort of thing; 5 percent of them get out of the laboratory.

The total income to the Federal Government from all of that research that we have done is $1 million. So if you are going to put a dollar figure to this research, what the Government is getting back from it directly, it is just hardly worth it.

We put $50 billion a year and we get $1 million total—well, since the Bush report in 1946, whenever that was.

Give me your thoughts on that. Make me feel that the $50 billion that we spend on research is really well spent.

Mr. FORRESTER. Well, in our neck of the woods, I think Coopers & Lybrand started auditing with the phone company and, perhaps, with Harvard. This was 70 years ago in Boston. At some point we added MIT to our list of valued clients. Then we started adding people like Raytheon and Digital Equipment, Milipor, Unitrode, and companies like that which had grown from the research that had been conducted, principally at MIT and at Harvard.

Today our practice is still strong, with a bit of a downturn in the last couple of years in the high-technological areas, but very strong in the financial services, venture capital area, where the venture capitalists in Boston are taking what they have learned, ideas and technology from MIT, that are starting small companies around Boston, and taking that to the rest of the country.

Just in a sort of second or third level from the research in a public accounting firm—we have a growth of from 200 people, when I joined the firm in 1973, in Boston, to almost 900 today. A lot of that growth comes from the ideas that are developed in this university research.

I think the same is true of many businesses which are in the New England area today. I am not as familiar with the rest of the country, but I suppose that.

Mr. LUJAN. We are looking at things that are done in the national laboratories, primarily. Granted that is, I guess, primarily, defense related and not too easily transferred into the private sector.

But it was a little sobering to me anyway to realize that we are not getting the benefit of that research out into the private sector as we should.

Anyway that is my thought for the day; thank you.

Mr. FUQUA. Mr. Brown?

Mr. BROWN. You indicated that we were approaching what you called a third wave of research since the World War II period, which, of course, leads to the question of whether it is best to support the national research program in a series of ways. But I didn't really want to get into that as much as why do you perceive that we are approaching a third wave of increased support for research in this country?

Mr. FORRESTER. Mr. Brown, I think it is a matter of demographics. That the children of baby-boomers, like myself, are now in late elementary school, and in junior high school, and will soon be moving on into college, where at the same time that this wave of students is approaching many of the faculty members who were hired when research universities grew in the 1960's are nearing retirement.

So we have a lot of very foresighted university presidents that I have talked to, and are most concerned about renewing their senior faculty in this 1990 to 1995 period at the same time they are going to meet the increasing demands of the students that are coming in at this time.

Mr. BROWN. So you see it as tied to the demographics of the situation?

Mr. FORRESTER. Yes, I do.

Mr. BROWN. And that was not true of the previous two waves. Those were spurred by concern about developments in space, the Sputnik, and the national defense issues in the World War II and the immediate post-World War II area. That is a rather interesting observation.

Does that seem desirable to you that the weight of our national programs in support of research should be tied to a variety of factors, the exigencies of defense, the threat of being superseded as the world's leader in space, or the fact that we had a bunch of kids so many years ago?

Mr. FORRESTER. Well, there is another factor, too; in many States the economy is leading people at State universities to develop programs that will spur high-technological growth there.

Mr. BROWN. I think that is the point that Mr. Lujan was trying to make. Perhaps our decline in national competitiveness would be a part of the spur to this increased national support for research.

I think that is a very proper and legitimate concern if we agree that the health of the basic research capability of this country is an important factor in national competitiveness. I think there are some who still don't agree with that completely.

But I presume you would agree that that is an important factor?

Mr. FORRESTER. From what I read. But I certainly couldn't speak as an authority in the connection of that to our national competitiveness.

Mr. BROWN. Tell me, is there any absolute criteria or standard that you can think of that would allow us to make some determination as to what is an appropriate level for the Federal Government to be involved in the health of basic research in this country; or does it have to be, as it has been obviously, a political decision based upon the collective wisdom of all of us high-minded Members of Congress?

Mr. FORRESTER. One could look at the amount spent for basic research in this country to the Federal budget, or the gross national product, and compare that with other countries. One could look ahead to the amount of stimulation that one hoped for from this and factor it back to the $5 back to $1, in the case that I described.

Or, one thought that is in the back of mind is that, as I said, the need to keep the flow of teachers in science moving. These people have to be taught and they have to have graduate training.

Mr. BROWN. It boils down to maintaining a situation of dynamic balance in which we consider all of these factors in some reasonable way. Unfortunately, I don't think most of the Members of Congress have had a sufficiently comprehensive view of all of the different factors that enter into this dynamic balance.

Of course, that is our hope, as a result of this study, that we will begin to perceive the complexity of this and be able to make these more reasoned judgments.

You haven't commented on the question of internal balance in this Federal role of support for research. For example, one of the major changes that has occurred in the last 6 or 8 years is the relative proportion of support for military versus civilian expenditures in terms of the support for research. Is that a factor that you think is significant in looking at the overall picture?

Mr. FORRESTER. Yes, I think that would be a factor in the financial health, particularly of the universities that either had a large part of that, or that didn't. I am familiar with a couple of universities where they have significant defense-related projects, and I can't say they are healthier than the others, but at least their general level of research is held up.

Another cut is the large projects of supercomputers versus the smaller individual grants that are described in the GAO's study in February. So that each particular university or maybe each particular school of engineering, medicine, whatever, within a university has to be evaluated on its own to see what the effect of this is going to be, because you may lose jobs in one area and need people in another, and would not be able to shift the people over to those other jobs.

Mr. BROWN. You also have, within the civilian sector, you have a situation which needs sophisticated analysis. We have been very good, I think, in supporting fundamental research in the health-related sciences for a generation now.

It has had a beneficial effect—I think no one would deny that—in terms of our understanding of basic biological process and biotechnology. On the other hand, we have not done a great deal—I don't know that it is necessarily the fault of the Federal Government, it has to be shared with private industry—in enhancing the health of our, let's say, manufacturing technology, which is commented on in earlier speeches.

So we really need to look at the balance and determine to what degree we want to preserve both the healthy medical science and health-related science, and a healthy manufacturing economy in this country, and make decisions based upon the degree of which we are getting out of kilter there. Would that be your observation?

Mr. FORRESTER. Yes.

I am very familiar with a professor down at Georgia Tech, who has a large NSF grant for manufacturing technology. Of course, the NSF is supporting health research as well.

Mr. BROWN. The emphasis on the manufacturing technology, however, is a recent growth, which is just beginning to develop, compared with the support for the biological sciences.

I have no further questions, Mr. Chairman.

Mr. FUQUA. Mr. Forrester, in your work with many of your clients of universities, is there some uniform method of accounting among all the universities?

I know we get back into this situation of overhead costs that I mentioned earlier. Is there a more uniform method of accounting being developed for universities, particularly research universities now?

Mr. FORRESTER. In indirect costs, sir?

Mr. FUQUA. Yes.

Mr. FORRESTER. No. They are diverse; A-21 is flexible. One suggestion might be a——

Mr. FUQUA. Should there be one?

Mr. FORRESTER. In doing my work I have often thought that it would be useful to have a disclosure statement as to what policies within the variety that could be used are being used there, the way a defense contractor over a certain level of volume has to make a disclosure statement to the Defense Department.

Should they be more uniform? I think the universities would argue that the universities are very different, that they should have the option to move things around to suit their needs, but at least to say what their policies are in black in white.

Mr. FUQUA. Well, not to tell each university which way to keep their books or anything, but they are general, like in business, if you have a form for the Securities Commission, or you give an annual evaluation of a business for their annual report and what they file with the Securities Commission.

There is a generally accepted form that that follows. Every business is a little different. But I am wondering if there should be maybe a uniform disclosure statement—maybe that is not good, I don't know, I am asking.

Mr. FORRESTER. Well, as far as the general university financial statements, those come under the accounting principles established by the American Institute of CPA's, 12 or 13 years ago. There are standard forms for those.

But the indirect cost calculations within A-21, as long as they meet that, can come in any particular from that you like.

Mr. FUQUA. Like how much of the president's salary is chargeable as indirect costs, or the dean?

Mr. FORRESTER. It may vary from university to university.

Mr. FUQUA. Yes.

There is a competition and peer review and other methods of evaluating scientific work but there is no way to evaluate cost, or to reduce costs. Should there be that part of the review when somebody is proposing for a grant?

Mr. FORRESTER. Well, it is my understanding that the peer review teams, the study sections and peer review teams that review these grants often have a financial person on them, and that the

opportunity is certainly there to ask, "Do we really need all these people on the grant, or do we need this or that?"

So I would suppose that those questions are being asked.

Mr. FUQUA. Thank you very much for being here today. You made a very enlightening statement. We appreciate very much you being here with us.

The task force will meet again Thursday, at 9:15.

[Whereupon, at 11:30 the hearing adjourned to reconvene on Thursday, September 18, 1986, at 9:15 a.m.]

SCIENTIFIC RESEARCH AND UNIVERSITY FINANCES

THURSDAY, SEPTEMBER 18, 1986

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SCIENCE POLICY TASK FORCE,
Washington, DC.

The task force met, pursuant to call, at 9:15 a.m., in Room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the task force) presiding.

Mr. FUQUA. We will continue our second session of meetings this morning on the Science Policy Task Force on Scientific Research and University Finances. We had a very excellent session on Tuesday of this week. Today we conclude these hearings.

Our first witness this morning will be Mr. David Lyons, Vice President and Treasurer of Rockefeller University, New York.

Mr. Lyons, we are pleased to have you this morning. We will make your statement that you have prepared a part of the record. If you wish to summarize you can certainly feel free to do so.

[A biographical sketch of Mr. Lyons follows:]

DAVID J. LYONS

David Lyons has held administrative appointments at three universities: The University of Chicago, 1961-1967; the University of Rochester, 1967-1970; and The Rockefeller University, 1970 to the present.

At the Rockefeller University, Mr. Lyons was Director of Economic Planning (1970-1971); Controller (1971-1982); Vice President (1978-1984); and Vice President for Business and Finance and Treasurer (1984-present). He was previously Assistant Director of Finance at the University of Rochester and Administrative Assistant to the Comptroller at the University of Chicago.

David Lyons received a B.A. degree from the College of the University of Chicago in 1957 and a M.B.A. degree from the Graduate School of Business of the University of Chicago in 1961. He was employed by Stewart-Warner Corporation in Chicago, Illinois, from 1957-1961, in several professional and supervisory assignments.

Mr. Lyons received the CPA certificate, State of Illinois, in 1964 and is a member of the Illinois Society of Certified Public Accountants, the American Institute of Certified Public Accountants, and the American Accounting Association. He was Lecturer in Accounting at Loyola University (Chicago) from 1964 to 1967 and Associate Lecturer in Accounting at the University of Rochester from 1968 to 1970.

David Lyons is active in several professional organizations. He is a member of the Board of Management of the Council on Governmental Relations and a member of its Costing Policies Committee; a member of the Financial Accounting Standards Advisory Council and chairman of its Committee on Nonprofit Institutions; a member of the Financial Accounting Standards Board Task Force on Nonbusiness Organizations; a member of the American Institute of Certified Public Accountants Task Force on Not-for-Profit Organizations; a member and past chairman of the Board of Directors of the FAS International Users Group; and was chairman of the Accounting Principles Committee of the National Association of College and University Business Officers.

He was recipient of the 1981 CAUSE award for exemplary leadership in the advocacy and support of administrative systems in higher education; the 1986 Neal O. Hines Publications Award for outstanding contributions to the publications program of the National Association of College and University Business Officers; and the 1986 Daniel D. Robinson Award for outstanding contributions to the field of college and university accounting.

STATEMENT OF DAVID J. LYONS, VICE PRESIDENT, BUSINESS & FINANCE AND TREASURER, THE ROCKEFELLER UNIVERSITY, NEW YORK, NY

Mr. LYONS. Thank you, Mr. Chairman. I have spent my entire professional career in financial management at research universities, so it is a great privilege to be able to provide testimony for this hearing. In particular, to review the July 1986 briefing report by the Government Accounting Office entitled, "Universities Finances, Research Revenues and Expenditures."

Scientific endeavors in American have long been linked with universities. Throughout this century, but especially in the last 40 or 50 years, there has been an ever-growing contribution from scientists at American universities to the quality of life for our country and for all people.

Maintaining and enhancing our scientific and technological leadership is an important national goal. Universities have an essential role in achieving this goal, and it is most appropriate to examine the financial condition of our research universities.

The GAO report is a useful and timely summary of revenue and expenditure components and trends for the past decade. It confirms the dominance of Federal funding for research in universities, although the Federal share of research revenues declined from 71 percent in 1975, to 66 percent in 1984. It is noteworthy that even in this generally difficult financial period, universities have increased research expenditures faster than Federal funding has grown.

As confirmed by the report, universities consistently make expenditures for new research facilities and equipment that are far greater than the depreciation or use charges included in Federal indirect cost rates.

The report notes that indirect costs as a percentage of total Federal funding to universities for research and development increased from 22 percent in 1975 to 26 percent in 1984. One only has to mention insurance costs and the cost of disposal of radioactive and other hazardous wastes, to mention only two overhead items that have had geometric cost increases in just the last few years.

However, one only has to look at the comparable research indirect cost rates of profit-making industries performing Federal contracts, to see how modes the indirect cost rates of research universities are.

What is needed on the part of the Federal Government is recognition that these costs are legitimate and that they are directly related to research productivity. The best research is done at institutions that provide the best research support. What is needed on the part of research universities is to continue to demonstrate managerial competence in handling research support functions and to demonstrate their cost effectiveness. It would also be helpful if universities could narrow their differences in accounting treatments and even in organizational structures so that we do not continuous-

ly have to discuss these differences. Instead, we should be discussing how to provide cost-effective support functions that will add to research productivity. We probably need to make a greater investment in these essential supporting services.

The recent proposal of OMB to pay a standard percentage allowance for faculty effort included in departmental administration is a good concept. Without commenting on the appropriateness of the percentage proposed, I would note that it does remove a great deal of the uncertainty and continuing discussion about one item of indirect costs that is truly difficult to document.

If there must be cuts in Federal funding of research, I hope these cuts will be made in the total amount of award and not selectively in the indirect costs component, which would simply put more of a burden on research universities if the same level of research is maintained.

During the GAO's study period, tuition and fees increased faster than inflation, specifically 60 percent in private institutions and 37 percent in public institutions. Universities cannot continue indefinitely to raise tuition and fee charges significantly higher than the annual inflation rate without at the same time providing new sources of funding for student aid and this would require additional Federal funding.

Throughout the GAO's report, State appropriations were shown to very significant for the financial operations of public institutions. However, different States at different times have unequal abilities to support higher education. It is very difficult for a State to provide the kind of continuing support that is needed for basic research. The States have an important, even critical, role to play in sustaining colleges and universities, and in funding research that will be helpful to the State's economic development, but they will not replace the Federal role in funding basic research.

The proposed new tax laws give us concern about our ability to continue to maintain the same percentage of support as we have in the past. This private money is important, sometimes all out of proportion to its magnitude, because it is frequently unrestricted or, at least, very flexible. It can be used for new ventures, for seed money, or to take a chance on promising young individuals until they have had a chance to demonstrate their abilities and attract funding from more conventional sources.

During the 10 years ended in 1984, the GAO report notes that industry support more than doubled and in 1984 accounted for 6 percent of research revenues. This increase, even on a small base, was welcome because it added diversity to our funding sources. We will continue to be on the alert for areas where faculty research interests are a good match for industry support.

However, the primary interest of a business corporation will always be in research that will add to the productivity or profitability of that company. Therefore, the research most likely to attract corporate support will be product related or in some way related to the business of the company. This excludes a lot of basic research where the role of continuing Federal support is indispensable.

We will probably see more collaborations with respect to applied research and in many cases this will be off campus or in industrial parks located on or near our campuses.

The GAO report also comments on the level of debt for physical plant. It is not possible to tell from the report what portion of this debt relates to research facilities and what portion does not. There is a role for debt in acquiring research equipment and facilities. University administrators, however, will be cautious about new borrowings at a time when there is uncertainty about future funding levels.

The GAO report notes the great concern among research universities about the condition of their research equipment and facilities. This is indeed a major problem as the House committee knows from its earlier hearings.

To launch or sustain a research effort is now a major capital budgeting decision. In the past few years, the Rockefeller University has launched seven new laboratories. For a typical laboratory, it was necessary to bring to the university 15 or 20 scientists and to expend several million dollars to renovate space, provide adequate instrumentation, and pay other startup costs.

Building support systems and fully equipped technical support facilities are essential to research productivity. All of this is expensive, and it is hard to obtain funding; but these unglamorous support systems add so much to scientific productivity, overall economy, and safety that the funding must be found to upgrade and enhance our Nation's research facilities. I believe the case should be made that relatively more Federal funding should go to this area, even at the expense of reductions in other research support. Reallocations alone will not be enough to offset a decade or more of inadequate investment in research facilities.

The most conservative estimates are that many billions of dollars must be expended in the decade ahead if universities are to continue to support leading-edge research. This is an urgent national priority.

One concern that was not mentioned in this GAO study is the level of salaries that are paid to researchers. We must find ways continuously to increase our salary levels so they are not a rising disincentive to embarking upon or continuing a research career.

GAO's analysis notes the view of university administrators that if Federal funding cuts were implemented there would be a reduction of new initiatives, a retrenchment of present programs, and a further erosion of the support for equipment and facilities. I agree there is no alternative funding source that could grow in the amount necessary to offset even modest Federal cuts.

Research increasingly is conducted by large teams in specialized facilities. Once these facilities and teams of persons are in place and are productive, they should be sustained to the greatest extent possible. It does not add to research productivity to be continuously worrying from year to year about whether funding will be available. If necessary it would be desirable to support a smaller number of scientists but in a more stable fashion.

I would like to comment on the effect of the proposed new tax laws on university finances. At the moment, it is easier to see negative consequences flowing from the new laws than positive ones.

We don't know what effect the reduction in the marginal rates will have on giving, but there is fairly good evidence that giving by higher income taxpayers is affected by the marginal tax rate. In addition, the new tax laws will cause many taxpayers who formerly itemized their deductions to take the standard deduction, and the new laws repeal any charitable deduction for taxpayers claiming the standard deduction. The untaxed appreciation on charitable gifts is now an item of tax preference and subject to the alternative minimum tax.

The reductions in individual income taxes are offset by fairly significant increases in corporate taxes. This will put pressure on the ability of business corporations to make gifts to universities. The new laws do retain the tax credit for incremental research expenditures and also retain the present law encouraging donations of newly manufactured scientific equipment to universities for research use.

In short, the likely changes in new tax laws seem to harm the financial condition of research universities at the same time that Federal budget cuts may be imposed.

All who have been partners in building and sustaining the research capabilities on our campuses should be proud of their efforts because from our laboratories have flowed discoveries that have brought such a great improvement in the quality of life for our country and for the world. There is an even brighter future emerging. Federal funding is needed now as always to sustain this critical effort. We are grateful for the very high priority that Congress has always placed in supporting basic research. We know that you will continue to provide support to the greatest extent possible. We applaud these hearings.

Thank you for this opportunity to present this testimony.

[The prepared statement of Mr. Lyons follows:]

INVITED TESTIMONY BY

DAVID J. LYONS

VICE PRESIDENT, BUSINESS & FINANCE, AND TREASURER

THE ROCKEFELLER UNIVERSITY

NEW YORK, NEW YORK 10021

before the

SCIENCE POLICY TASK FORCE

COMMITTEE ON SCIENCE AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

SEPTEMBER 18, 1986

It is a privilege to be able to provide testimony for this hearing of the Science Policy Task Force of the United States House of Representative's Committee on Science and Technology; in particular, to review the July 1986 Briefing Report by the General Accounting Office entitled, "University Finances -- Research Revenues and Expenditures."

Scientific endeavors in America have long been linked with universities. Throughout this century, but especially in the last forty or fifty years, there has been an ever-growing contribution from scientists at American universities to the quality of life for our country and for all people. Examples are easy to cite and they range from advances in health care, to agriculture, to industrial processes, to military strength and to the general standard of living for all.

Maintaining and enhancing our scientific and technological leadership is an important national goal. Universities have an essential role in achieving this goal, and it is most appropriate to examine the financial condition of our research universities. The examination is complicated by the fact that universities have multiple goals, encompassing education, public service and research. It is not possible to divide revenues and expenditures with great accuracy among these different objectives. The overall financial health of the university is essential for all of its components. It is precisely this complex environment that has proved so conducive to scientific progress.

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GAO REPORT

The General Accounting Office report is a useful and timely summary of revenue and expenditure components and trends for the past decade. It confirms the dominance of federal funding for research in universities, although the federal share of research revenues declined from 71% in 1975 to 66% in 1984. It is noteworthy that even in this generally difficult financial period, universities have increased research expenditures faster than federal funding has grown. Some of this increase came from growing industrial support, but there was also growth from gifts, endowment income, and allocations of unrestricted funds.

As confirmed by the report, universities consistently make expenditures for new research facilities that are about ten times greater than the federal agencies permit for governmental reimbursements (under grants and contracts) for depreciation or use charges. Equipment expenditures are double the federal reimbursements for depreciation or use charges.

INDIRECT COSTS

The report notes that indirect costs as a percentage of total federal funding to universities for research and development increased from 22% in 1975 to 26% in 1984. This is always a difficult topic for university financial administrators both in internal discussions with scientists and in external discussions with funding grantors. In the early years of the study period, energy costs were certainly one factor in the sharp increase. In the last year or two, falling energy costs have been a very helpful factor as we have performed our annual indirect cost rate computations. However, a number of other factors will continue to put pressure on indirect cost rates. One only has to mention such items as insurance costs and the

cost of disposal of radioactive and other hazardous wastes, to mention only two items that have had geometric cost increases in just the last few years.

There was a period, perhaps fifteen or twenty years ago, when one could well have commented that universities should do a better job of managing these indirect costs more efficiently. In the last decade, however, there has been a dramatic improvement in the management of indirect cost functions. In many cases with which I am familiar, we not only equal but exceed the abilities of our counterparts in the business sector. In such diverse areas as energy conservation, telecommunications, food service, and on and on, economic adversity has forced us to re-organize, to automate, and to improve our management systems. One has only to look at the comparable research indirect cost rates of profit-making industries performing federal contracts, to see how modest the indirect cost rates of research universities are.

What is needed on the part of the federal government is recognition that these costs are legitimate and that they are directly related to research productivity. The best research is done at institutions that provide the best research support. What is needed on the part of research universities is to continue to demonstrate managerial competence in handling research support functions and to demonstrate their cost effectiveness. It would also be helpful if universities could narrow their differences in accounting treatments and even in organizational structures so that we do not continuously have to discuss these differences. Instead, we should be discussing how to provide cost-effective support functions that will add to research productivity. We probably need to make a greater investment in these essential supporting services.

We could, of course, charge more of the indirect costs as direct costs of research. In some cases, we have had to do this for nonfederal sponsors who will not pay indirect costs, but who willingly pay for the costs of space, energy, and research support functions, which make up the indirect cost rate. However, to do this for federal funding would mean installing cost accounting systems throughout the university which are really counter to the environment of a university and would invite continuing problems of audit. I very much hope that this can be avoided.

The recent proposal of OMB to pay a standard percentage allowance for faculty effort included in departmental administration is a good concept. Without commenting on the appropriateness of the percentage proposed, I would note that it does remove a great deal of the uncertainty and continuing discussion about one item of indirect costs that is truly difficult to document.

If there must be cuts in federal funding of research, I hope these cuts will be made in the total amount of awards and not selectively in the indirect costs component. If the latter is done, it would simply put more of a burden on research universities which will have to continue to provide supporting services if the same level of research is maintained or, in the alternative, reduce supporting services for research, with resultant reduction in quality.

TUITION AND FEES

During the GAO's study period, tuition and fees increased faster than inflation, specifically 60% in private institutions and 37% in public institutions. These increases were needed particularly to continue to improve faculty salaries, but universities still have not been able to catch up from years of

high inflation when they could not possibly give pay increases equal to the inflation rate. However, universities cannot continue indefinitely to raise tuition and fee charges significantly higher than the annual inflation rate without at the same time providing new sources of funding for student aid and this would require additional federal funding. Therefore, I do not see any opportunity here to bring in significant amounts of new resources that could benefit research.

STATE APPROPRIATIONS

Throughout the GAO's report, state appropriations were shown to be very significant for the financial operations of public institutions, and in many states there is some help for private institutions also. However, different states at different times have unequal abilities to support higher education. One has only to look at the agricultural states today or the oil-dependent states to see examples of retrenchment and inability to fund institutions of higher education to the same extent as in the past. With respect to supporting research, it is quite understandable that states are more receptive to specific research projects that relate to the economic base of the state or to bring in particular industries, for example. It is very difficult for a state to provide the kind of continuing support that is needed for basic research. The states have an important role to play in sustaining colleges and universities, and in funding research that will be helpful to the state's economic development, but they will not replace the federal role in funding basic research.

GIFTS

During the study period, private gifts and endowment income accounted for between 12 and 13% of educational and general operating revenues. This is an average percent; the

percent was higher for private institutions and lower for public institutions. The percent of research revenues funded from gifts, endowment income, foundation funds, and allocations of unrestricted funds increased from 14% in 1975 to 17% in 1984. Certainly no university can flourish, or perhaps even survive, without dedicated and committed constituents who support the objectives of the university both financially and with their talents and advice in many areas. Research universities can be especially proud of having attracted loyal groups of supporters including foundations, business corporations, alumni and other individuals. These supporters believe in our work and are generous in their support of it. However, the magnitude of expenditures to be funded is such that it is hard to believe there can be a dramatic growth in the percent of our revenues coming from these sources.

Indeed, the proposed new tax laws give us concern about our ability to continue to maintain the same percentage of support as we have in the past. This private money is important, sometimes all out of proportion to its magnitude, because it is frequently unrestricted or, at least, very flexible. It can be used for new ventures, for seed money, or to take a chance on promising young individuals until they have had a chance to demonstrate their abilities and attract funding from more conventional sources.

INDUSTRIAL SUPPORT

During the ten years ended in 1984, the GAO report notes that industry support more than doubled and in 1984 accounted for 6% of research revenues. This increase, even on a small base, was welcome because it added diversity to our funding sources. We will continue to be on the alert for areas where faculty research interests are a good match for industry

support. We have also received very generous support from industry in the form of unrestricted grants for basic research.

However, the primary interest of a business corporation will always be in research that will add to the productivity or profitability of that company. Therefore, the research most likely to attract corporate support will be product related or in some way related to the business of the company. This excludes a lot of basic research where the role of continuing federal support is indispensable.

With respect to corporate support of projects of specific interest to the company, it should be noted that this frequently carries with it some conditions that are hard to accept on campuses. There may be requirements to maintain proprietary data in confidentiality, to work under national security classification, to delay publication, or even to delay discussion of research results pending a review as to their patentability. There may well be a growing opportunity to take the results of basic research and find corporate support for its application to particular products. This might bring some revenues to the university through the mechanisms of patents and royalties. We will probably see more collaborations with respect to applications and in many cases this will be off campus or in industrial parks located on or near our campuses.

DEBT

The GAO report also comments on the level of debt for physical plant. It is not possible to tell from the report what portion of this debt relates to revenue producing facilities and what portion does not. At The Rockefeller University, we have for a long time felt that the appropriate use of debt was for long-term revenue producing assets, such as apartment houses, where it seems probable that tenant rents will be at a

sufficient level to fund debt service payments in addition to operating costs. There may be some special opportunities for borrowing funds, to make expenditures that will result in significant cost savings during a very short period. One example would be installing a new telecommunication system where one can see the initial costs and related debt service payments being repaid by cost savings within a period of just a few years. We would hope that in such cases our sponsors will be understanding and supportive of participating in these debt service costs. There is a role for debt in acquiring research equipment and facilities. University administrators, however, will be cautious about new borrowings at a time when there is uncertainty about future research funding levels.

RESEARCH EQUIPMENT AND FACILITIES

The GAO report notes the great concern among research universities about the condition of their research equipment and facilities. This is indeed a major problem as the House Committee knows from its earlier hearings. Some quantitative data are available in a publication of the National Science Foundation dated August 1985 entitled, "Academic Research Equipment in Selected Science/Engineering Fields, 1982-83."

To launch or sustain a research effort is now a major capital budgeting decision. In the past few years, The Rockefeller University has launched seven new laboratories. For a typical laboratory, it was necessary to bring to the University fifteen or twenty scientists and to expend several million dollars to renovate space, provide adequate instrumentation and pay other start-up costs. Yet there is practically no federal funding available for construction of research facilities, although some funds are available to assist with equipment purchases and minor renovations.

Building support systems are also essential to research productivity, including air handling systems, special drain systems, and emergency generator power back-up so that experimental results are not lost, just to give a few examples. Fully equipped technical services are also required; including animal research facilities, computing facilities, instrument shops, and glassware washing facilities, to name just a few. All of this is expensive, and it is hard to obtain funding; but these unglamorous support systems add so much to scientific productivity, overall economy, and safety that the funding must be found to upgrade and enhance our nation's research facilities. I believe the case should be made that relatively more federal funding should go in this area, even at the expense of reductions in other research support. Reallocations alone will not be enough to offset a decade or more of inadequate investment in research facilities. The most conservative estimates are that many billions of dollars must be expended in the decade ahead if universities are to continue to support leading-edge research. This is an urgent national priority.

SALARY LEVELS

One concern that was not mentioned in this GAO study is the level of salaries that are paid to researchers. Throughout the country, there are many postdoctoral fellows and junior faculty members receiving very low salaries relative to cost of living. For the more senior scientists, the gap between their salaries and what they could earn in the profit-making sector is also often great. Our concern is not just to retain the present scientific staff, but also how to continue to recruit the brightest and most talented young persons to embark upon careers of research. The dedication of our younger staff to science is awe-inspiring, but they do have concerns about meeting family obligations. We must find ways continuously to

increase our salary levels so they are not a rising disincentive to embarking upon or continuing a research career.

FEDERAL FUNDING CUTS/CHANGES

GAO's analysis notes the view of University administrators that if federal funding cuts were implemented there would be a reduction of new initiatives, a retrenchment of present programs, and a further erosion of the support for equipment and facilities. I agree there does not seem to be any alternative funding source that could grow in the amount necessary to offset even modest federal cuts.

Research increasingly is conducted by large teams in specialized facilities. Once these facilities and teams of persons are in place and are productive, they should be sustained to the greatest extent possible. It does not add to research productivity to be continuously worrying from year to year about whether funding will be available. In this connection, the recent announcements by the National Institutes of Health of two new awards, the FIRST award and the MERIT award seem promising. The FIRST award, available to promising young investigators, provides up to five years of support and is not renewable after that time, but it does gives a young investigator a reasonable period of time to demonstrate research productivity. The MERIT award goes to established investigators who have demonstrated outstanding productivity and competence. It provides an initial five-year award with the possibility of five years of renewal. This kind of stable support should be most helpful in terms of research productivity. If necessary it would be desirable to support a smaller number of scientists but in a more stable fashion.

NEW TAX LAWS

I would like to comments on the effect of the proposed new tax laws on university finances. At the moment, for universities, certainly it is easier to see negative consequences flowing from the new laws than positive ones.

We don't know what effect the reduction in the marginal rates will have on giving, but there is fairly good evidence that giving by higher income taxpayers is affected by the marginal tax rate. For example, if you wish to give $40,000 to a university, and you are in the 50% tax bracket, the real cost in making that gift is $20,000. If you find yourself in the 28% tax bracket and wish to give $40,000 to a university, the effective cost is $28,800 to make that gift. In addition, the new tax laws will cause many taxpayers who formerly itemized their deductions to take the standard deduction, and the new laws repeal any charitable deduction for taxpayers claiming the standard deduction. If this were not enough, the untaxed appreciation on charitable gifts is now an item of tax preference and subject to the alternative minimum tax. This will affect gifts of appreciated property including securities, which are frequently received by universities.

The reductions in individual income taxes are offset by fairly significant increases in corporate taxes. This will certainly put pressure on the ability of business corporations to make gifts to universities. The new laws do retain the tax credit for incremental research expenditures and also retain the present law encouraging donations of newly manufactured scientific equipment to universities for research use.

Some additional negative consequences of the law include the increased taxation of scholarships and fellowships, the possibility that there will be imputed taxable income in

connection with apartment rentals to university staff members, even where such rentals fully fund all operating costs, reduced opportunities for staff members to tax shelter funds for retirement, and restrictions on the ability of private institutions to issue tax-exempt bonds.

In short, the likely changes in new tax laws seem to harm the financial condition of research universities at the same time that federal budget cuts may be imposed.

CONCLUSION

All who have been partners in building and sustaining the research capabilities on our campuses should be proud of their efforts because from our laboratories have flowed discoveries that have brought such a great improvement in the quality of life for our country and for the world. There is an even brighter future emerging. Federal funding is needed now as always to sustain this critical effort. We are grateful for the very high priority that Congress has always placed in supporting basic research. We know that you will continue to provide support to the greatest extent possible. We applaud these hearings.

Thank you for this opportunity to present this testimony.

DISCUSSION

Mr. FUQUA. Thank you very much, Mr. Lyons, for a very informative statement. You touched on several areas that we are concerned. Nonetheless, even with the tax bill, we are still trying to find out what is there.

From your background I think you can provide an excellent answer. The present system of funding university research has a strong emphasis on the project content. But there is nothing in the proposals to try to determine competitiveness as to who can do that research at the lowest cost. Would that be a good way to try to get the cost of research down, or would we cause other problems in approaching it from that fashion? I am really talking about using both; the content as well as the cost of that.

Mr. LYONS. First of all, I think there is too much looking at inputs and not at outputs. It isn't the lowest cost, but where can you get the greatest discovery—what you pay for the discovery that DNA is a substance that transmits heredity.

I think that there is too narrow a focus on the project itself and on the cost of that project. There should be a greater focus on the track record of the scientists involved and the other areas within that institution that can interact with that project and are likely to bring out a better outcome.

So, yes, you want to get the most bang for the buck, but it isn't where can you do this research the cheapest, where can you do this research most effectively, because you want discoveries; you want progress.

Mr. FUQUA. We have discussed that in some of our earlier hearings, particularly about the track record of the individual. How do you bring along the new investigator if you only go back to the track record? How does somebody get on that track?

Mr. LYONS. One of the points in my longer paper is that the NIH does have a program now that identifies gifted young persons and assures them 5 years of support. We have been doing this for years with private money to launch people who seem promising. We rely on their professors in college and other contacts, and we put our bets on these young people, give them a few years of funding from private money, then they can go out and compete because they have made some progress and they can demonstrate something. So, you need both.

But what hurts the system, is so many people are in there applying every year. Some get turned down and some get funded and 2 years later they lose their grant. Then they have to drop out for a while. That is inefficient. Research should not be conducted that way.

Mr. FUQUA. Getting back to a variation of the first question. As we know, some universities or research centers have lower costs than others; they compute their costs in a different fashion.

Should there be some type of uniformity of what can be costed out or charged as overhead particularly as it relates to other items? I am not talking about necessarily the laboratory items used in a chemistry course, or the materials used, but when you start charging out plant and equipment and administrative costs.

Mr. LYONS. In my view, there should be more uniformity, but you will never get complete uniformity. Part of this has to do with organizational differences, and that is the great strength of our system here in this country; that every State can organize its universities differently.

But surely we ought to agree on which items are part of the overhead and which are direct. Surely we ought to agree on standard depreciation rates. Surely we ought to agree that watching and guarding is part of general institutional—or part of O&M—so that we don't have to constantly explain these differences.

A great deal of work is being done by the financial accounting standards board in setting uniform standards.

Mr. FUQUA. You would support that effort then?

Mr. LYONS. Definitely. Even if the outcome isn't perfect it would be uniform and that then has a powerful influence on our internal accounting systems. Increasingly, our computer systems are robust enough to get around some of these organizational differences, and deliver more common data.

But there is a new threat on the horizon; a new standard setting body, the Government Accounting Standards Board has been formed to set standards for State and local governments and their entities. It apparently is going to assert jurisdiction over public institutions of higher education. Sixty percent of the institutions in America are private; 40 percent are public. That would split us down the middle with very different accounting standards, and that would be a great tragedy for all concerned. That is a very recent development. So while we are just about making progress with FASB, we have GASB emerging and saying, "We want part of that turf."

Mr. FUQUA. Well, Thank you very much, Mr. Lyons. We appreciate you being here this morning and sharing with us your wisdom on this very complex subject.

Mr. LYONS. Thank you.

Mr. FUQUA. Our next witness will be Dr. Joseph Froomkin, president of Joseph Froomkin, Inc., of nearby Chevy Chase, MD.

Welcome, Dr. Froomkin, we are delighted to hear from you. I see you have a prepared statement and then an oral statement. We will take your prepared statement and make it part of the record. If you wish to present the other statement, please do so.

[A biographical sketch of Dr. Froomkin follows:]

DR. JOSEPH FROOMKIN

Education: B.A., 1946, St. John's University (Shanghai, China); M.B.A. 1947, Ph.D., 1950, University of Chicago. Research Assistant and Fellow, School of Business, University of Chicago, 1947–49.

Positions held: President and Research Director of Joseph Froomkin Inc., Washington, D.C., May 1971 to Present.

Heads analysis group that performs studies of educational, social and economic issues. Director of the Department of HEW's Educational Policy Research Center for Higher Education and Society, 1975–79.

Vice-President, Simat, Helliesen and Eichner, Inc., Washington, D.C., November 1970-May 1971.

Participated in the economic analysis of the *Concorde* airplane. Project director of a cost analysis study of elementary and secondary education for the President's Commission on School Finance.

Program Planner, I.B.M. Corporation, Washington, D.C., September 1969–November 1970.

Worked on I.B.M.'s data processing strategy for the Federal market.

Assistant Commissioner for Program Planning and Evaluation, U.S. Office of Education, Washington, D.C., October 1966–September 1969.

Headed the policy advisory group in the Office of Education concerned with planning, evaluation, and the application of systems analysis of education programs; reviewed budgets and new program proposals, U.S. representative to Educational Planning Committee, Organization for Economic Cooperation and Development, Paris, and ex-officio member of White House Education Task Force, 1967–68.

Manager, Marketing Plans, Data Processing Division, I.B.M. Corporation, White Plains, N.Y., October 1957–October 1966.

Various positions, latest listed above, on corporate and divisional staffs in operations research, marketing, market research, including a manager of the Data Processing Division's market research department. Set industry marketing targets and recommended allocation of resources needed to meet sales goals.

Economist, Aeronautical Research Foundation, Cambridge, Mass., July 1955–October 1957.

With a group of Harvard Business School faculty co-authored three operations research studies: (1) forecast of international air freight, (2) second-hand aircraft prices, and (3) air traffic forecasts for the Federal Aviation Administration's Curtis Committee on National Requirements for Aviation Facilities.

Research Associate, International Program in Taxation, Law School of Harvard University, Cambridge, Mass., January 1954–July 1955.

Performed research and taught parts of seminar on business taxation and capital formation in Latin America.

Active duty, United States Army. January 1952–December 1953.

Research Associate, Bureau of Applied Social Research, Columbia University, New York, New York, June 1951–December 1951.

Worked on international comparisons of the effect of labor force skills on industrial location.

November 1950–June 1951, Research Associate, Mayor's Committee on Management Survey, New York, N.Y.

Wrote a study comparing the costs of performing municipal services in different U.S. cities.

February 1950–November 1950. Economic Affairs Officer, Fiscal Division, United Nations, New York.

Wrote regional surveys and worked on special projects for the Director.

Teaching: International Tax Policy Seminar, Harvard, 1954–55; Corporation Finance, Baruch School, C.C.N.Y., Nights 1958–59.

Foreign lectures and consultings: Three months of lecturing and consulting on strategic planning in Japan, sponsored by the Japanese Productivity Council and U.S. Aid Administration, 1966.

Two-week tour of lectures on marketing in Morocco, sponsored by the Administration for International Development, 1969.

Consultant to Organization for Economic Cooperation and Development in Paris, France, on labor force status of college graduates, 1982.

Languages: French, Russian, some Chinese.

Books and monographs: *Technology and Jobs.* (with A.J. Jaffe), Praeger, New York and London, 1968.

Students and Buildings, Government Printing Office, Washington, D.C., 1968.

Aspirations, Enrollments and Resources: The Challenge to Higher Education in the Seventies, Government Printing Office, Washington, D.C., 1970

Needed: A New Federal Policy for Higher Education, Institute for Educational Leadership, Washington, D.C., 1978.

Editor of: *Proceedings of the Conference on Agricultural Taxation,* International Program in Taxation, Cambridge, Mass, 1954.

Education in the Seventies. Government Printing Office, Washington, D.C., 1968.

Education as an Industry, (with D.T. Jamison and R. Radner), National Bureau of Economic Research, Ballinger, Cambridge, Mass., 1976.

The Crisis in Higher Education, The Academy of Political Science, New York, 1983.

Author of numerous articles and Government reports dealing with the planning and financing of higher education.

STATEMENT OF DR. JOSEPH FROOMKIN, PRESIDENT, JOSEPH FROOMKIN, INC., WASHINGTON, DC

Dr. FROOMKIN. Thank you very much, Mr. Chairman. I would like to take this opportunity to thank the committee for giving me an opportunity to present my views on the role of research and development grants on the financial health of universities.

The concern of the committee is extremely timely. The finances of research universities are in balance this year. However, a number of students of their financial conditions are concerned that these institutions are enjoying only a temporary reprieve, and that in the near future they may once again face financial hardships.

There are four emerging trends which could threaten these institutions financial health: The threat that the Federal funds for research will be cut; the effect of a downturn of economic activity on their finances; losses in tuition revenues, and State aid in case of public institutions, if enrollments decline; and finally, the impact of the new tax bill, especially as it affects the level of gifts, the willingness of students to finance their education with loans, and the costs of financing new facilities.

The most immediate threat is that Federal grant moneys will shrink. Research moneys play an even greater role in financing of the purely educational and research functions of the universities than the GAO report tells us. For instance, in the case of research universities, or universities which give doctoral degrees, they amount to 29 percent of their educational research funds in the case of private institutions; and 90 percent of public institutions. The Federal Government plays a dominant role in providing those funds.

More importantly, between 50 and 80 percent of the budgets of medical schools at major research universities, after patient revenues have netted out, are covered by appropriations. Roughly, 50 percent of the private doctoral granting science department budget is provided by Federal sources.

Clearly, any across-the-board cut is likely to affect private institutions much more seriously than public ones. For instance, a 10-percent cut in the research budgets of the University of Chicago, amounting to roughly $8 million would equal the 20 percent of the university's income from endowment. Even the most generous endowed universities, such as Harvard and Yale, would feel such a loss.

After the Federal Government and the States the third most important source for research is the university budget itself. About 10 percent of all research is financed from unrestricted funds of universities. The ability to fund these outlays depends upon the macroeconomic policy of the Federal Government. To put it bluntly, more money is available to universities during a full employment period or a period when the economy is growing rapidly. For instance, between 1982 and 1984 in the relatively mildly recovery which we have had, both public and private universities increased their expenditures on research about 50 percent. During the same period, total research expenditures in science and engineering increased only 24 percent.

The current economic recovery cannot last forever. Almost inevitably, efforts to reduce the budget deficit will cause a slowdown in the economy. With the economy turning down, the revenues of institutions will suffer. Revenues of colleges and universities are cycle-sensitive. This must be taken into account in the grants and contract policy.

Industry is not likely to solve the problems of the research establishment. It contributed less than 5 percent or so, of total funding research for 1984. Industry funded 3.6 percent of the total science and engineering outlays in the 10 top public institutions, and less than 5 percent of the total spending of the 10 private universities.

Industry funds play a bigger role in the budgets of universities which do not support important research-oriented medical schools. Among the top 10 recipients of industry funds for research, the schools with the highest proportion of such funds in their budgets were Carnegie-Mellon, 23 percent; Georgia Institute of Technology, 20 percent; Pennsylvania State University, 13.6 percent; MIT, 11.7 percent; and Purdue, with 10.8 percent of the research budget coming from industry.

By contrast, other major recipients of industry funds, such as Stanford and Minnesota, financed only 5 percent of their activity with industry funds. Most of industry's support goes to institutions with strong engineering departments. Institutions such as the University of Chicago, with no engineering school, receive little or no support from this source.

Most research institutions will not be able to make up losses from Government grants by increasing tuition levels. They will be too busy competing for students in the next few years as undergraduate enrollments decline. Leading research universities are wrong if they expect to be insulated from this threat.

Already the percentage of tuition earmarked for scholarships has increased dramatically in most research universities. These increases would be needed to keep enrollment at desirable levels. Or to be more precise, to keep the enrollment of desirable students at desirable levels.

I am more optimistic about the impact of the new tax bill on university finances. According to studies of philanthropy, most large donors are not motivated by tax considerations, so one need not anticipate a significant decline in the amount of gifts to educational institutions. Nor is the enrollment likely to decline because of the increased reluctance of students to borrow.

Most college students do not behave as strict maximizers, or enrollments would have declined drastically starting in 1980, when the difference between the earnings of college graduates and those of high school graduates narrowed. A small increase in the price of borrowing is unlikely to affect the propensity of students to enroll.

On the other hand, provisions of the new tax bill governing the tax-exempt borrowing for new facilities of college and university buildings may affect construction adversely. New bonds issued for this purpose will no longer be as attractive and may require a higher coupon.

Financial stringency is likely to be experienced by universities in the next year or two, whatever happens to Government contracts. The situation will be aggravated if cuts in Federal and other Gov-

ernment research funds are made. We would do well to start planning now for this eventuality and decide whether we want to protect the strongest research centers or allow them to fend for themselves the best they can.

Neither the National Academy of Sciences' annual review of proposed budgets nor the recent report of the Packard Commission address the issue of priorities for the allocation of Federal funds by disciplines or between institutions. Only in the context of a clearly articulated science policy, which is precisely the agenda of this committee, can the Federal Government decide how to ensure the financial health of our leading research universities.

Thank you very much.

[The prepared statement of Dr. Froomkin follows:]

Prepared Testimony for the U.S. House of Representatives, Committee on Science and Technology, Hearing on Scientific Research and University Finances, September 18, 1986

After experiencing a period of rapid growth from 1950 to the early 1970's, the leading research universities went through a difficult period of no-growth or contraction for nearly a decade, ending in 1982. Now they are enjoying a renewed period of relative ease. However a number of analysts of the financial conditions of research universities are concerned that the current period is only a temporary reprieve, and that in the near future universities may once again face financial hardships.

The volume of science/engineering research undertaken by research universities is directly related to the amount of moneys they can command not only from grants and contracts for research but also other revenues from students in the form of tuition, from state legislatures as subsidies, from endowments, and from and profits from services which they perform. There are four threats to the ability of these institutions to safeguard their research capability: (1) the possibility that the federal government's research and development appropriations will be cut across the board to balance the budget, (2) the possible effect of a downturn of economic activity on their finances, (3) losses in tuition revenues (and state aid for public institutions) if enrollments decline, and (4) the unfavorable impact of the new tax bill, especially as it affects (a) the level of gifts to institutions, (b) the willingness of students to finance their education with loans, and (c) the cost of financing new facilities.

RESEARCH OUTLAYS IN TOTAL BUDGETS OF RESEARCH UNIVERSITIES

The ever-present threat is that appropriations for research will be reduced to balance the budget. Funds from government sources for research, development, and contract activities in leading doctoral granting institutions account for roughly one-sixth of their budgets. For instance, during fiscal 1984, total government grants and contracts contributed some 17 per cent of private and 14 per cent of public current fund revenues in doctoral granting institutions.

In fact, these moneys play an even greater part in financing the purely educational and research functions of these institutions. They amount to roughly 22 per cent of all revenues if one nets out activities which have little to do with instruction and research: patient fees received by hospitals, and the receipts of auxiliary enterprises such as dormitories, bookstores etc. Private doctoral granting institutions depend on these revenues much more than the public institutions. Government sources provide 29 per cent of private institutions' revenues and 19 per cent of public institutions' revenues.

More importantly, the share of the education and research budget covered by government grants varies considerably from department to department. While precise figures are difficult to obtain, to the best of my knowledge, between 50 and 80 per cent of the budgets of medical schools with major research programs (after the patient revenues are netted out) are covered by government appropriations. Roughly 25 percent of the typical private doctoral-granting school of arts and sciences's budget is provided by government sources. Within such schools, science departments generally derive half of their budgets from government grants and contracts.

ROLE OF THE FEDERAL GOVERNMENT

Nationally, roughly sixty per cent of government grant and contract money goes for research and development in science fields. Doctorate granting institutions channel a higher proportion of these moneys to science/engineering research and development. I estimate

that in research-oriented universities 85 per cent of the moneys provided by the federal government and nearly 75 per cent of the moneys provided by state and local governments were used for this purpose in 1984.

The federal government plays a dominant role as a provider of research and development funds. Nearly two-thirds of all the moneys for science/engineering research come from this source. Nearly a quarter of education and research moneys in private institutions come from the federal government. Public institutions, which also receive funds from states, receive somewhere between eight and ten per cent of their budgets from federal funds.

Clearly, any across-the-board cut is likely to affect private institutions much more seriously than public ones. For instance, a ten per cent cut in funds for research and development to the University of Chicago, amounting to roughly $8 million dollars, would equal 20 per cent of the university's income from endowment. Even the most generously endowed universities, such as Harvard and Yale, would feel such a loss; a 10 per cent cut, roughly $10 million, would represent five and ten per cent of the endowment income of these two institutions. Such amounts cannot be made up easily from other sources.

OTHER SOURCES OF FUNDS FOR RESEARCH AND DEVELOPMENT

After the federal government and the states, the third most important source of moneys for research is the university budget itself. About 15 per cent of the total research funding comes from university funds. This is roughly three times as much as the amount contributed by industry.

The ability to fund these outlays depends upon on the macroeconmic policy of the federal government. To put it bluntly: more money is available to universities during a full-employment period or a period when the economy is growing rapidly.

Public institutions are most directly affected by the level of economic conditions. During periods when the economy does not grow or there is a depression, state tax revenues are lower and the moneys available to higher education are reduced. Private institutions, and

to a lesser extent public schools, feel the effect of economic slowdowns indirectly as their tuition levels, which are influenced by the level of family income, do not grow as rapidly.

The effect of a depressed economy on institutions is quite pronounced. The economic slowdown during the late 1970s and early 1980s cost public schools some 20 per cent of their income. Private institutions lost some six to ten per cent of their revenues.

After the economy rebounded in 1982, the research universities increased their spending on research and development from their own funds. The ten public institutions with the largest research budgets increased their spending on science/engineering from non-federal and non-industry sources by 49 per cent, from $338 million in 1981 to $481 million in 1984. During the same time period, the ten private universities with the largest research budgets increased their science/engineering expenditures from funds other than federal and industry by the same 50 per cent. This increase amounted to $76 million. Between 1981 and 1984, total research and development expenditures increased 24 per cent.

Much attention has been paid to industry's funding of research and development. Starting from a small base, this source of funds has grown faster than all others in the past ten years. Nevertheless, the sum total of industry financing of research in the science/ engineering fields did not amount to more than five per cent of the total funding for this purpose in 1984. Industry funded 3.6 per cent of the total science/engineering outlays in the ten top public institutions, and less than five per cent of the total spending in the 10 top private universities.

Industry funds play a bigger role in the budgets of universities which do not support important research-oriented medical schools. Among the top ten recipients of industry funds for research, the schools with the highest proportion of such funds in their budgets were Carnegie Mellon (23 per cent), Georgia Institute of Technology (20 per cent), Pennsylvannia State University (13.6 per cent), M.I.T. (11.7 per cent), and Purdue (10.8 per cent). By contrast, other major recipients of industry funds, such as Stanford and Minnesota, financed only five per cent of their activity with industry funds. Industry funds paid for a larger share of the budget

at Cornell (7.6 per cent) and Arizona (8.2 per cent). Most of industry's support goes to institutions with strong engineering departments. Institutions such as the University of Chicago, with no engineering school, receive little or no support from this source.

FUTURE STRAINS IN INSTITUTIONAL FINANCES

The higher education establishment is haunted by the prospect of a decline in undergraduate enrollments. Such a decline is inevitable: It has already started, and it will continue for the next five to ten years. However most leading research universities expect to be insulated from this trend and hope to continue rationing admissions spaces, turning down some students who would meet their admission standards.

I am not sure that they are correct. State legislators are reluctant to close down institutions; they may require the public research universities to contract their enrollments to some extent in order to allow regional institutions, which are less attractive to students, to maintain their enrollments. Private research universities may prove quite vulnerable to enrollment declines. They attract students who are eager to enter post-baccalaureate professional programs such as medicine, law and business, and as the financial and professional rewards from these degrees diminish, the number of students willing to pay the private schools' high fees may decline. There are some early harbingers of this trend. In a number of instances, most notably the University of Chicago, the percentage of tuition earmarked for scholarships has increased dramatically. These increases were needed to keep enrollments at desirable levels.

The current economic recovery cannot last forever. Almost inevitably, efforts to reduce the budget deficit will cause a slow-down in the economy. With the economy turning down, the revenues of institutions will suffer.

Colleges and universities are not considered to be a cycle-sensitive industry. On the contrary, recent research has shown that enrollments are likely to be above trend during a recession. Nevertheless, from the point of view of those who wish to safeguard a given level of research and development, the impact of variations in

employment cannot be ignored. It would be advisable to document this impact more precisely.

THE EFFECT OF THE TAX BILL

Another area of uncertainty is the new tax bill's impact on university finances. The two features of the tax bill which have received the most attention are the lower tax rate's possible effect on the motivation of donors and the non-deductibility of interest paid on student loans. Yet they may have less effect on the finances of research universities than alarmists expect. According to studies of philanthropy, most large donors are not motivated by tax considerations, so one need not anticipate a significant decline in the amount of gifts to educational institutions. Nor is enrollment likely to decline because of the reluctance of students to borrow. Most college students do not behave as strict maximizers either, or enrollments would have declined drastically starting in 1980, when the difference between the earnings of college graduates and those of high school graduates narrowed. A small increase in the price of borrowing is unlikely to affect the propensity of students to enroll.

On the other hand, low-cost borrowing for construction of college and university buildings may be seriously affected. In the past, even schools with substantial endowments found it profitable to borrow by issuing tax-exempt bonds rather than use their endowment to finance construction. With the new tax bill, the attractiveness of these bonds may be reduced and construction may be affected adversely.

ISSUES IN THE SHORT TERM

Since financial stringency may return to the universities in the next year or two, together with cuts in federal and other government research funds, we would do well to start planning now. We may want to ask ourselves how to reorganize the current research establishment to have it operate more effectively.

A top-priority issue, in my opinion, is to assure that the most gifted researchers who will earn their Ph.D.s during the next decade have access to the facilities of research universities. A high proportion of excellent Ph.D.'s may not find jobs in institutions with adequate research facilities. Would it be possible, for instance, to redirect funds from the justly criticized postdoctoral programs to provide summer stipends for promising investigators to continue their scientific work in research universities, as well as some payment to the host institutions?

This move may lead to an orderly discussion of how many facilities and how much equipment are needed. The research establishment's dissatisfaction with its accommodations and its tools is endemic. Yet few will argue that research facilities in the United States are the best in the world. In each discipline, there may be one installation that is more up-to-date or luxurious in some other country, but the overall state of our research laboratories is unrivalled anywhere.

We could do even better if we had a national policy for research. At present, we scatter our shots and our resources. There are at least five or six, and usually ten, research locations in every discipline which consider themselves first rate and feel they ought to have the very best equipment. There are between ten and 20 strong universities which will enter new and exciting scientific fields irrespective of cost.

Past experience has demonstrated that institutions with good research records generally find ways to construct needed facilities and acquire necessary equipment. Unless another downturn in their fortunes materializes, there is no urgency for a federal program to subsidize these outlays.

Strong congressional direction is needed to target research funds to centers of excellence in different disciplines. The peer reviews of applications for government grants have institutionalized, and will continue to protect, the status quo. Before the federal government even considers subsidizing new facilities and equipment, it ought to reassess the current distribution of grants not only geographically but also by discipline. To judge by the last 10 years' shares of each discipline in the federal research and development

budgets, we are a nation of hypochondriacs: half of our research outlays is in health-related fields. By contrast, social science research has been cut to the bone; its share in federal appropriations declined by nearly half during the past five years and now amounts to only six per cent of the total. Is this a reasonable policy in a society which is increasingly service-oriented and where sophisticated information-handling and superior organization are essential ingredients to ensure competitiveness?

Neither the National Academy of Sciences' annual review of proposed budgets nor the recent report of the Packard Commission address the issues of allocation of federal funds by discipline or between institutions. A national science policy should address these issues. As a by-product of such a policy, the federal government might enunciate more clearly how it can ensure the financial health of our leading research universities.

DISCUSSION

Mr. FUQUA. Thank you very much, Dr. Froomkin. You mention that funding for universities, in particular research and higher education is very cyclical, and subject to a lot of different factors beyond their control, such as say, in times of severe budget constraints, as we are faced with today, or times of severe economic stress such as depression, that may—and many people are predicting—may come about in the next few months or year.

You never know when one comes until after it is there and then you find out that you have it. But be that as it may, how could you protect against those types of cyclical funding levels, which everyone admits are not good, probably not good for anything?

It would be good if we had a very stable economy all the time, with a little growth factored in and never had to worry about all these other things, trade deficit, budget deficits, recessions, inflations and all the other factors that seem to feed against that.

Dr. FROOMKIN. Well, as you know, research and development is the very tip of a tail which is being wagged by a very big dog, of all the other economic problems. Under those circumstances you may want to have a policy of nominating a number of so-called national research centers, the funding of which would be protected, and then to have additional project funds available to others; this is one possibility.

Mr. FUQUA. Well, what about university research centers?

Dr. FROOMKIN. There will be university research centers.

Mr. FUQUA. But you would only name a few?

Dr. FROOMKIN. I would name only maybe, 30 or 40.

The other thing is I would like to make very, very sure that if they are named as national research centers, that some mechanism for access of researchers and faculty from other institutions isn't institutionalized. You see we have a great deal of equipment in most universities.

Some of it is very good; some of it is good; some of it is mediocre. About 2 years ago I went around to 30 or 40 major research universities, talking to the people in the science establishment, and they told me that basically there were at least 3 or 4 institutions in the United States which, if they didn't have the best facilities, had the second best facilities in the world. And then there were a lot of others which have inadequate facilities. Now the people in adequate facilities are having a great deal of trouble matching the quality of research with those people who have very good or good facilities.

Giving the access of those people—and we have more talent in this country than we know what to do with—is, I think, a very important problem.

In my full testimony I mention the fact that you might want to redirect some of the money from the increasingly criticized postdoctoral program, into an access program for junior faculty, and this might be one way of doing it. But I think it is very important to make sure we protect a number of institutions and universities from the ups and downs which are caused by things which are completely extraneous to their goals and their targets.

Mr. FUQUA. Mr. Walker?

Mr. WALKER. Thank you, Mr. Chairman.

I am just interested in noting your testimony that two of the top three universities who got industry money for research are in Pennsylvania: Carnegie-Mellon and Penn State, and it just occurs to me, do you know any reason for that to be the case?

Dr. FROOMKIN. The reason is really the entrepreneural character of the administrations in both places. Now I would like to remind you that Carnegie-Mellon has been nurturing a program in information sciences for over 20 years, mostly out of their own hide. Now they are collecting to go from research and development, and that is where the money comes from.

The University of Pennsylvania is an absolutely outstanding center of ceramics, and a number of applied centers which are considered to be absolutely the very best in the whole world.

Mr. WALKER. So in other words, the attitude of the university and the nature of the direction of the administration wants to go, and the commitments that the universities make themselves, are very much involved with whether or not they attract that industry funds?

Dr. FROOMKIN. Yes, but a lot of these industry funds are not going to be for what we call absolutely pure research. They will be somewhere between research and development, you see.

They will be for certain applications. And before a university can make a bid for those funds they have to invest a great deal of money in pure research to be able to offer something to industry.

Mr. WALKER. But once they have done, if I understand correctly here, Carnegie-Mellon that you just talked about, is getting 23 percent of their moneys out industries at this point.

Dr. FROOMKIN. Yes, but they don't have a medical school either.

Mr. WALKER. OK; all right, so in other words, that does make a difference in terms of those percentages. But Penn State does. Penn State is getting 13.6 percent. Does it have a medical school?

Dr. FROOMKIN. That is right. It is not a very research-oriented medical school.

Mr. WALKER. One other question that you did not mention among the things that threaten the financial health of institutions is the whole question that we have dealt with recently in the Congress, about Congress deciding where the research money will go in a political fashion rather than having the money decided upon through a peer review process within the scientific community.

I would like to have you comment on that, if possible; it seems to me that in a time of dwindling resources the last thing we want done is Congress deciding to apportion the dwindling research dollar on a political basis.

Dr. FROOMKIN. Well, I was on a number of committees in the late and increasing lamented Johnson administration, when we were trying to distribute research more evenly throughout the country; and I was not too terrible about what happened there.

I would like to tell you that most academics think that politicians are doing awful things. And I would like to say that most observers of the scene have much more sympathy for what the politicians have tried to than the academics would like to tell you.

The peer review process assures that the status quo is continued. Because whenever you have a review of proposals by peers and you

see a big research center name on that proposal, that gives you about 5 to 10 points in the rating on the proposal.

By contrast, in the case of ceramics for instance, there is nobody better than Penn State, which is not a big research center—or highfalutin research center by anybody else's standards—and those things get lost between the cracks.

Now my feeling is that politicians will just have to make up their minds how many research centers they want—first-rate ones—and where. And the academics will have to live with it; and also give access to other academics to those research centers.

I am afraid that if you are going to have less money, some political decisions will have to be made. And I am telling you that what ever political decisions you make, the academics are not going to like them.

Mr. WALKER. So, in other words, if I understand correctly, you are comfortable with the trend that has taken about a $10-Million amount of money of 3 years, that was being apportioned on a political basis, and has taken it to nearly $70 million at the present. In other words, we have had almost a seven-fold increase in that we are apportioning on a political basis in a 3-year period.

Do I understand you to say that you are comfortable with that trend?

Dr. FROOMKIN. No, I am not comfortable with the standards by which it is appropriated.

Mr. WALKER. There really are not standards. The standards by which we are doing that appropriation around here right now is who happens to be chairman of a subcommittee at the time that the money is going through there, and what institution in their district wants that money. That is largely the standard by which we are apportioning research money around here at the present time. And if I hear you correctly, you are saying that that may be a valid process and I have tell you as somebody who watches the process work, I am not so certain that it is a valid process.

Dr. FROOMKIN. Look, I am not too happy when plus $10 million—I felt you people work very hard and you ought get somebody who is know for their proficiencies. When it was $20 million, all right. When it got to be $30 million, $40 million, $50 million, it started getting a little bit uncomfortable. What I am saying is get some standards and then apply the political process.

If you are going to do it on a long-rolling basis—look, some of the money went for a new genetics lab in Berkeley for instance, if I remember correctly. I watch those things.

Mr. WALKER. But we also had things added on the House floor where we didn't even know whether or not they had facilities available to do the research that we were giving them $5 million for. At the time we decided to put $5 million into the budget on the House Floor because someone came running to the Floor with an amendment. We didn't even know whether they had a facility capable of handling the $5 million, and found out later, indeed, they didn't. So that was $5 million lost to the research effort for at least a year. Most recently they have come back for even more money for that project so that they can now build the facility.

I am really questioning whether or not that is a process that fits in with the need to have the best use of research dollars.

Dr. FROOMKIN. Well, there is good politics, and there is bad politics.

Mr. WALKER. That is true.

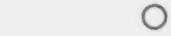
Thank you, Mr. Chairman.

Mr. FUQUA. Thank you very much, Dr. Froomkin, we appreciate your being here this morning and likewise sharing your views with us.

Dr. FROOMKIN. Thank you very much.

Mr. FUQUA. This concludes the meeting today.

[Whereupon, at 10 a.m., the hearing adjourned.]



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